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Atlas of Diatoms of Jiuzhaigou National Nature Reserve

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It's our duty to make sure that air, land, and water are looked after by everyone in today's society so that tomorrow's generations inherit a cleaner, healthier world

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Foreword

Jiuzhaigou is located on the eastern slope of the Tibetan Himalayan Plateau, at the intersection of the subtropical and temperate floristic zones of the Sino-Himalayan Region. The floristic units of subtropical Southwest China and temperate Northern China meet the floristic elements of the Tibetan Plateau and Central Asia, so Jiuzhaigou has a very high species diversity. The unique features of the Jiuzhaigou travertine sites are the result of interactions between water and biokarst, with the deposition of travertine sediments forming dike barriers in the riverbed. The study was conducted at six sites in the river arm of Jiuzhaigou National Nature Reserve.

Diatoms are microscopic algae whose typical feature is a siliceous shell called a frustule, which is extremely diverse in shape. Diatoms live in almost all types of surface waters. Depending on the habitat, diatoms are either planktonic (living suspended in water), benthic (associated with a substrate), or both planktonic and benthic. On the one hand, planktonic diatoms usually have fine frustules and/or long appendages to facilitate buoyancy. On the other hand, benthic diatoms do not require fine structures because they live on a substrate. Therefore, they do not have to worry about sinking. All types of algae that develop in an area depend on various environmental factors: salinity, temperature, pH, water velocity, shading, depth, availability of substrates for growth, water chemistry, etc. Therefore, the species present in a water body provide information about some of the characteristics of the water. Characteristics such as small size, rapid growth, high abundance, and wide distribution make them suitable model organisms for ecological topics such as succession, competition, energy transfer, predator-prey relationships, food web structures, etc.

As the most abundant photosynthesizers in water, diatoms are an important group of algae for maintaining unique travertine ecosystems. Due to their great diversity and the expertise required for their identification, they have been rarely and incompletely studied in the Jiuzhaigou area. Therefore, this atlas is the first to

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comprehensively present the diatom community in the aquatic biotopes of Jiuzhaigou National Nature Reserve.

This book is the result of long-term of international scientific cooperation between the People's Republic of China and the Republic of Croatia based on ecological protection of the natural heritage of Jiuzhaigou Nature Reserve and Croatia's Plitvice Lakes National Park. In 2019, the China-Croatia "Belt and Road" Joint Laboratory for Biodiversity and Ecosystem Services was established as one of the first joint laboratories recognized by the Chinese Ministry of Science and Technology.

The book may provide useful information on freshwater diatoms in Jiuzhaigou National Nature Reserve, their ecology, biodiversity, and their important role in the ecological enhancement of water resources. The book is aimed at a wide audience, from those with a general interest in the world's environment to those who need an overview of the global and regional context to improve planning, management, and investment decisions.

Authors

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Chapter 1

About Jiuzhaigou National Nature Reserve

Geographical Location

Jiuzhaigou National Nature Reserve (hereinafter referred to as the "Reserve") is located in the northeast of the Gongga Mountains in the southern part of the Minshan Mountains, with Gansu to the north, the Qinling-Daba Mountain System to the northwest, the Longmen Mountains to the east, the Plateau Grassland to the west and the Minshan Mountains to the south. It belongs to Zhangzha City, Jiuzhai Valley County, Aba Tibetan and Qiang Autonomous Prefecture, Sichuan Province. Its geographical location is $103^{0}46'10''\sim104^{0}03'38''$ E, $32^{0}54'19''\sim33^{0}16'15''$ N, 40.5 km long from north to south and 35.4 km wide from east to west. The reserve is bordered on the east by Ganzi Gonggai Mountain Peak, Majiaxiang Township, and Wanglang National Nature Reserve, on the south by Huanglong Temple Reserve in Songpan County, on the west by Bimang along the main ridge of Zamaqiemudepu Mountain in Songpan County, Tazang Township bordering Jiuzhai Valley Pass, the administrative boundary of Shuntazang Township, and the mountain ridge to the north of Zharugou, covering a total area of 643 square kilometres.

Topography

The reserve is located southeast of the Qinghai-Tibet Plateau and is the transitional area between the two geomorphological units of the Qinghai-Tibet Plateau and the Sichuan Basin. It lies in the watershed in front of the first topographic stage of P.R. China, high in the south and low in the north, with towering peaks and deep river valleys. Jiuzhaigou Valley has an extension of about 30 km from north to south, with the main tributaries of Zharugou Valley, Rizegou Valley, and Zechawa Valley, and an average slope of 44%. There are 89 mountains with altitudes of more than 3500 m, including 68 mountains with altitudes of more than 4000 m, and 19 mountains with altitudes of more than 4500 m, the highest peak being 4764 m. The altitude of Goukouyangdong is 1996 m, the relative altitude difference is 2768 m, and the average relative altitude difference is more than 1600 m. The river valleys are scattered in the reserve. The density of the river network is more than

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0.8 km/km^2, the width is mostly less than 200 m, the maximum width-to-depth ratio is up to 20:1 and the average depth ratio is 4.5:1.

The landforms in Jiuzhai Valley can be mainly divided into the following categories: (1) landforms formed by modern seasonal ice, snow, and frost weathering at an elevation above 4000 m in the ridge area; (2) periglacial landforms in the alpine shrub meadow belt above the tree line at an elevation of 3800 m; (3) remnants of landforms formed by Quaternary paleoglacialization above 2900 m; (4) catastrophic landforms on slopes; (5) landforms in valleys; (6) dry karst landforms; (7) karst limestone accretionary landforms, etc.

Climatic Characteristics

Jiuzhaigou County, where the reserve is located, lies in the southern part of the Minshan Mountains, in the Qinling-Daba wetland of northern subtropical P.R. China, and in the transitional area of the Bomi-Western Sichuan wetland of the Qinghai-Tibet Plateau. The Longmen Mountains in the east block the warm and humid air blowing from the Pacific Ocean, and the Qinling Mountains in the north weaken the cold high-pressure flow from Mongolia. Influenced by the highland monsoon and the tropical ocean monsoon, the foehn effect is pronounced. Vertically, the climate in the reserve can be divided into dry and warm, wet and cool, cold and wet, dry and cold, and other types.

According to the Nuorilang Meteorological Station in the center of the reserve, the annual average temperature in the reserve is 7.3 °C, while in the hottest month (July) it is 16.8 °C and in October, it is 8.3 °C. The average temperature in the coldest month (January) is −8.7 °C, the extreme maximum temperature is 32.6 °C, and the extreme minimum temperature is 17 °C. The annual rainfall is 622 mm and it rains on average of more than 150 days. Precipitation falls mainly between May and September, often in the form of storms. The annual precipitation rate is relatively low, ranging from 10% to 15%, with the amount of precipitation increasing with altitude. In winter, it is snowy and snowfalls are frequent. The maximum snow depth is more than 15 cm. The annual sunshine duration is about 1800 h and the cumulative temperature with a daily average temperature of ≥10 °C. In winter, there is slightly more sunshine than in summer, and the winds are comparatively weak, with an average annual wind speed of $1 \sim 2$ m/s.

Rivers and Water Resources

The Jiuzhaigou River, the largest of its kind in the reserve, rises on Ga'erna Peak in the Minshan Mountain Range. It is a tributary of the upper reaches of the Baishui River, the right tributary of the Bailong River west of the source of the Jialing River in the Yangtze River system, and covers an area of 642.97 km^2, with the density of the water system being 0.8 km/km^2 and the annual average flow at the mouth of the valley being 9.03 m^3/s. There are a large number of lakes in the area, including 118 Haizi, concentrated in Rizegou and Shuzhenggou. The area of the lakes varies greatly. The largest is Changhai with an area of 0.93 km^2, while the smallest is only a few square meters in size. The lakes of Jiuzhaigou are close to each other and are called group lakes. The group lakes are mostly connected with waterfalls, such as the Shuzheng and Nuorilang sights.

Soil Characteristics

The Jiuzhaigou stratum belongs to the Jinchuan stratum community of Malkang and the Motianling stratum community of West Qinling. Except for some thin sandstone, shale, and carboniferous strata, the Devonian stratum in Jiuzhai Valley is mainly composed of limestone, dolomite, quartz sandstone, and sandy shale with a thickness of about 2400 m. The Carboniferous layer is mainly composed of gray medium-stratified sandy argillaceous limestone, dolomite, massive limestone, and clastic limestone with intercalations of shale and iron claystone; the Permian layer is composed of medium-stratified limestone, bioclastic limestone, siliceous limestone, and decomposed carbonaceous shale; the Triassic layer is mainly composed of calcareous dolomite, argillaceous limestone and bioclastic limestone with intercalations of calcareous shale. The Quaternary layer consists mainly of limestone deposits, alluvium, loess gravels, and lake deposits from the valley floor. The carbonate is mainly composed of pure thick-bedded limestone, dolomite, and bioclastic limestone with a total thickness of 4000 m, most of which are shallow marine and coastal strata, and there are few deep marine strata.

Due to the complex and diverse natural conditions in Jiuzhai Valley, the soil there has complex and diverse characteristics. As the climate changes greatly vertically and there is enough space for the development of the vertical soil belt, the structure of the vertical belt spectrum is complete, and the distribution law for the different soil types from low to high altitude is mountain cinnamon soil – mountain brown soil – mountain dark brown soil – mountain limestone soil – subalpine meadow soil – alpine meadow soil – alpine permafrost.

Vegetation Resources and Types

The reserve is remarkably rich in vegetation resources. There are 207 species (varieties, subspecies, or forms) of vascular plants belonging to 607 genera in 148 families, 72 species of rare and endangered plants, and nationally protected plants belonging to 50 genera in 23 families, including 3 species of nationally protected Class I plants (including ginkgo, yew, and clover), 64 species of protected Class II plants and 18 species of rare and endangered plants. Native seed plants in the reserve account for 38.28% of the total number of families, 17.41% of genera, and 6.98% of species; families, genera, and species represent 67.54%, 36.64%, and 22.26% of the total number of seed plants in Sichuan, respectively.

As a national nature reserve, famous scenic spot, and world natural heritage, the proportion of vegetation in the reserve is 85.5% and the proportion of forest is 63.5%. The reserve has rich and unique vegetation types. The main characteristics of the vegetation in the reserve include:

(1) The reserve has an excellent geographical and ecological environment with a variety of mountain, valley, water, and soil types. The elevation range of the mountains is up to 2768 m. The vegetation types are rich and diverse, and the vertical spectrum of vegetation is exceptional. From the valley bottom to the highest peak of the basin, there are deciduous broadleaf forests, temperate coniferous and mixed broadleaf forests, temperate coniferous forests, and cold

temperate coniferous forests. In addition, there are various marshes, shrubs, meadows, and sparse vegetation at Quick Stone Beach.

(2) The reserve is more than 1900 m above sea level, and most of its ridges are up to 4000 m high. The vegetation is dominated by alpine and subalpine landscape types, mainly fir, spruce, and larch forests, alpine shrubs, and meadows. In the high mountains, round-leaved berle or shrubs are common, while azalea forests or shrubs are more common in wetter places. The secondary pioneer community consists mainly of birch and Populus davidii, and there are many species of lime and maple.

(3) In a belt in Jiuzhai Valley at an altitude of 2000 ~ 3000 m, willow shrub is the representative vegetation species in the reserve. It is mainly distributed on the beach dam of travertine sediment between Shuzhenggou and Rizegou, mainly calcareous beach shrubs, mixed with a small amount of birch, poplar, oak, spruce, and so on.

(4) There are various kinds of aquatic plant communities. At the altitude of 2000–3000 m in Jiuzhai Valley, there are a number of submerged, floating, or emergent plants in the shallow parts of many Haizi and the nearby marsh and semi-marsh areas. The main types of vegetation include reed, North P.R. China scissors, bulrush, *Cunninghamia lanceolata*, rushes, *Vitex trifolia*, etc.

Chapter 2

Common Facts About Diatoms

Diatoms (Bacillariophyceae) are a large group of eukaryotic (with a membrane-bound nucleus) microalgae (cells ranging in size from 2 μm to 500 μm) that are ubiquitous in aquatic ecosystems. They are the most common photosynthesizers (they produce their own food in the same way as plants), live in water or even in wet habitats or soils, and occur in nature as single, solitary cells, some of which can form various types of colonies (bands, fans, zigzag lines, or star-shaped colonies that are buoyant and resistant to sinking). Diatoms typically live as free-swimming species (in ponds, lakes, and oceans) and form part of the ecological assemblage as phytoplankton. Planktonic species often have special adaptations to prevent sinking, such as forming long chains of cells connected by silica gel spines. Other diatom species grow on a variety of substrates (submerged plants, sand grains, and rock edges) as part of the ecological assemblage known as periphyton. These species may simply rest on the substrate, be directly and closely attached to the substrate, or be connected to the substrate by long stems (short or long and branched). The stems serve to hold the cells in place and are resistant to waves or strong currents in rivers. Stems also appear to serve to draw nutrients from the water. The variety of physical habitats available to the attached diatom explains some of the great diversity of this group. Diatoms live in all the lakes, oceans, rivers, and streams of the world. They even live in springs, on rock walls, in deserts, and soil. Their diatom walls are deposited in lakes and oceans and are a testament to environmental change and health. The many species of diatoms are distributed across space in non-random patterns that scientists are actively trying to explain. Diatoms require dissolved inorganic nutrients, including carbon dioxide, nitrogen, phosphorus, silicon, and a variety of metals and vitamins, to photosynthesize and reproduce. Different species are more efficient at obtaining certain nutrients than other species. These factors contribute to the diatoms' ability to use a variety of habitats and explain the existence of so many diatom species.

Diatoms live in houses made of glass. They are the only organism on earth whose cell walls are made of transparent, opal silica. The silicified cell wall forms a cushion-shaped shell (frustulum) composed of overlapping valves (epitheca/epivalva and hypotheca/hipovalva) interspersed with intricate and filigree patterns. The cell walls of diatoms are decorated with intricate and striking patterns of silica. Food is

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stored in the form of oil droplets, and the golden-brown pigment fucoxanthin masks the chlorophyll and carotenoid pigments that are also present. Diatoms have light-absorbing molecules (chlorophyll *a* and *c*) that absorb energy from the sun and convert it into chemical energy through photosynthesis. Through carbon fixation, diatoms remove carbon dioxide (CO_2) from the atmosphere. The CO_2 is converted to organic carbon in the form of sugars, releasing oxygen (O_2). We breathe in the oxygen that diatoms release. Diatoms produce long-chain fatty acids. Diatoms are an important source of these energy-rich molecules, which are food for the entire food web, from zooplankton to aquatic insects, fish, and whales.

Diatoms are traditionally divided into two great groups, usually distinguished by the symmetry of the valves: (1) the round, immobile, centric diatoms, which are typically round when the valve surface is viewed (radial markings), and (2) the elongate diatoms with bilateral symmetry, which are typically long and narrow. However, there are many exceptions to this classification. A more reliable distinction is made based on the pattern of symmetry of the valves (actually, near-symmetry, since the valves are never perfectly symmetrical) as follows. The great diversity of diatoms in turn reflects the great diversity of habitats in the aquatic environment. The shape, form, and physiology of diatoms vary in ways that suggest they have adapted to the different environments in which they occur. However, the taxonomy of diatoms is currently in flux as researchers continue to discover new species, reanalyse the morphology of type specimens, and apply molecular methods. Diatoms, which have a special structure called a raphe, can move across surfaces. These diatoms can move over fine grains of sand or in the mud of an intertidal zone or even on other diatoms. Diatoms have different abilities to move depending on the species. The more developed the raphe, the faster the diatoms can move. During reproduction, usually by cell division, the overlapping halves of the shell separate, and each secretes a (usually) smaller lower half. The individual diatoms that result from successive lower halves thus become smaller and smaller with each division. Within a few months, the average size can decrease by up to 60%. Periodic sporulation serves to restore the diatom line to its original size.

Every year scientists discover new species. Diatoms are very precise when it comes to the quality of the water they live in. For example, species have certain pH levels and salinity levels in which they can grow. Diatoms also have a certain range and tolerance to other environmental variables, such as nutrient concentration, suspended sediment, current conditions, elevation, and various types of human intervention. Diatoms are essential for assessing and monitoring the biotic status of water bodies. Almost all diatoms are microscopic Scientists use light microscopes (LM) or scanning electron microscopes (SEM) to view diatoms. When diatoms are viewed with a light microscope, the silica cell walls appear transparent (because we are looking through glass). When diatoms are viewed with a scanning electron microscope, the cells appear opaque (because we are looking at the surface of the cell with electrons).

Climate affects diatoms in complex ways. As the planet warms due to increases in carbon dioxide, scientists predict that larger marine plankton-like diatoms will decline compared to smaller plankton-like coccolithophores and cyanobacteria. In lakes and rivers, climate change is altering the flow of rivers in many parts of the world. The frequency and severity of droughts and floods are changing, affecting diatom species and their locations. The climate also controls the circulation patterns and thermal stratification of lakes and oceans, changing the composition of diatom species. Diatoms affect climate on a global scale. When diatoms photosynthesize, they "breathe in" carbon dioxide from the atmosphere and "breathe out" oxygen. Although diatoms are very small, they live in the world's large oceans. The fixation of carbon by diatoms and the release of oxygen change the chemistry of the atmosphere.

The wide diversity of diatoms and the relationship between diatom species and specific environments have made diatoms a popular tool for ecologists looking for indicators of environmental change and health. Traditional ecological work with diatoms involves comparing the flora of lakes, rivers, and/or oceans over space and time and relating species abundance to environmental factors. Repeated observations of a diatom species under certain conditions allow scientists to hypothesize that these conditions are the best factors for the growth of that particular species. The best examples of this are found in the study of eutrophication, acidification of lake systems, and climate change. The economic importance of diatoms is great, both indirectly and directly. Indirectly, they provide a large amount of high-quality food for the food web; knowledge of diatoms is important for understanding and managing the environment, and diatoms are used in geological exploration. Direct (the silicate of the walls adsorbs many ions) – Deposits of diatom shells can be thousands of meters thick and are mined for commercial purposes (as filters and chemical purifiers or for water purification). Diatomaceous earth is used as an abrasive or matting agent in polishes and paints. Diatoms are also particularly useful bioindicators for water quality monitoring and in the field of biostratigraphy (correlation of paleolimnological/geological strata). Diatoms from clothing or shoes have been used to link criminals to crime scenes.

The many unanswered questions and a new understanding of diatom diversity and its role in the global ecosystem ensure that the field of diatom biology remains wide open for those interested in the primary science describing biodiversity and its role as environmental indicators of climate change on Earth and in understanding the health of our environment.

Chapter 3

Diatoms of Jiuzhaigou National Nature Reserve

General Approach

It is well known that the composition and abundance of diatom species reflect the biotic conditions of freshwater ecosystems. Along with aquatic invertebrates or "bugs" and fish, diatoms are an indispensable component of environmental monitoring and assessment programs, especially in water quality assessments. Diatoms are sensitive to human impacts on watersheds, and the status of diatom populations reflects the response of the aquatic ecosystem to environmental stresses.

The study was conducted in six areas of Jiuzhaigou Nature Reserve branch (figure 1), and each sampling point was documented with GIS coordinates and photographs.

Sampling and Analysis

At each sampling site, benthic diatom samples were carefully scraped off (figure 2) and removed with a toothbrush from 3 randomly collect natural rocks (average-size rocks of about 15–30 cm). Prior to sampling, the stones were gently shaken in water to remove any loosely attached sediments and non-epilithic diatoms. Diatom suspensions were pooled to form a single sample that was then put in a labeled plastic bottle.

Two different microhabitats were identified for tracking diatom colonization in the periphyton community: Arrow Bamboo Lake (latitude: 33.140533/longitude: 103.8712/elevation: 2627 m; N 3308′25.919″ E 103052′16.32″) and Reed Lake (latitude: 33.2223562/longitude: 103.910006/elevation: 2200 m; N 33013′20.482″ E 103054′36.02″). Two artificial experimental panels (bricks, figure 3a) were placed at each site. The experiment was conducted from April to May 2015 and 2019. The artificial substrates (glass slides) were placed horizontally and parallel to the flow 10 cm below the water surface. The microhabitats consisted of seven glass slides attached to the top of a brick. Three repetitive glass slides were carried out after 5, 10, 15, 20, 25, 30, and 35 days of their exposure to the water (figure 3b).

On the day of sampling, the artificial substrates were carefully brought to the surface and placed in a labeled plastic bottle with a septum for proper slide insertion (figure 4a) and filled with water from the sampling site. Species diversity was

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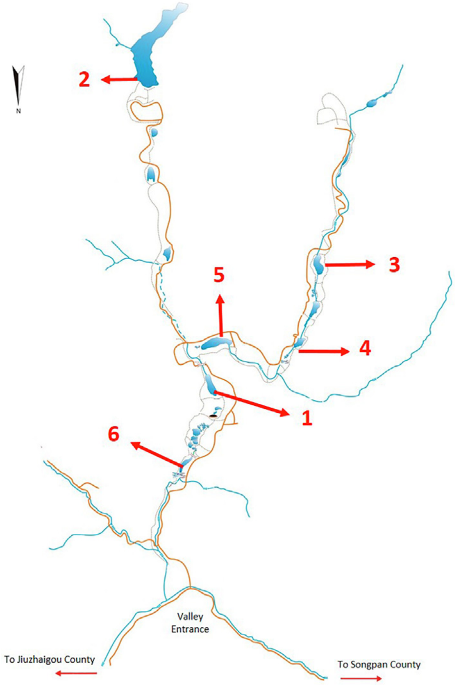

FIG. 1 – Location of the sampling sites in the branch of Jiuzhaigou Nature Reserve (1 = Rhinoceros Lake, 2 = Long Lake, 3 = Arrow Bamboo Lake, 4 = Mirror Lake, 5 = Peacock Riverbed, and 6 = Reed Lake).

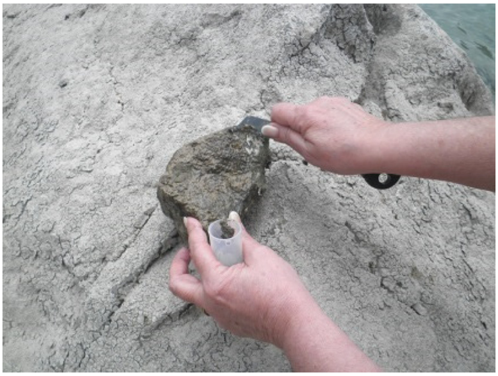

FIG. 2 – Sampling of benthic diatoms.

determined by counting specimens in 170 microscope patches. Microscopic examinations were performed on an exposed slide for as long as the periphyton density allowed. The periphyton was then scraped off and suspended in a specified volume (figure 4b). The total number of diatom cells was calculated per cm^2.

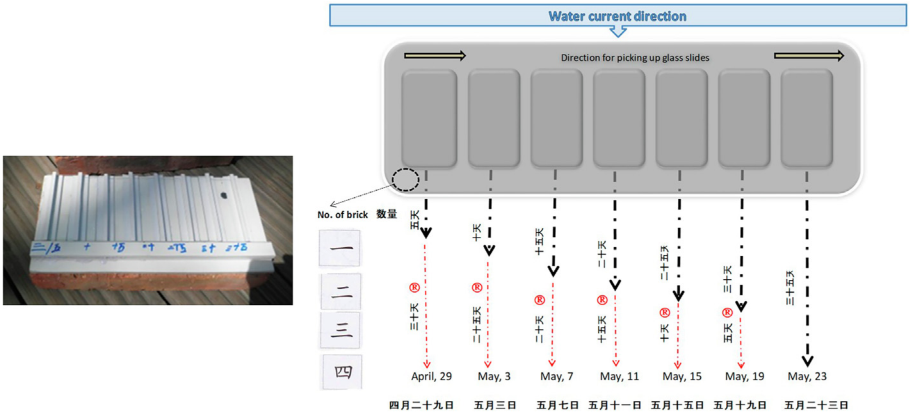

FIG. 3 – (a) Experimental artificial plate/brick; (b) scheme of the experimental artificial plate with microscope slides during the sampling period.

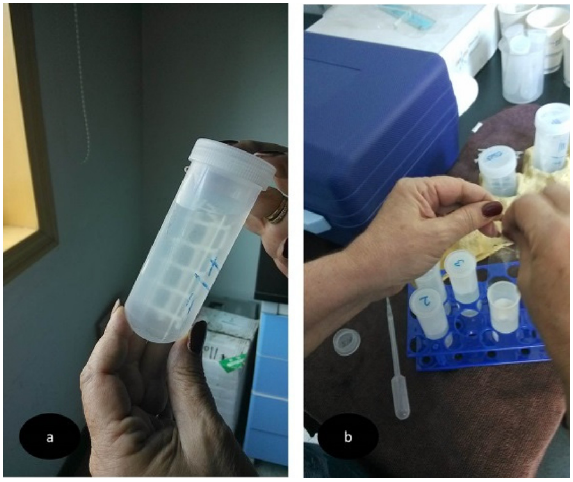

FIG. 4 – Labeled plastic bottle with a septum for proper investment of glass slides (a), and scraping off experimental artificial substrate/glass surface (b).

Diatoms can be determined to species level based on the morphological characteristics of their frustules only if their siliceous frustules are previously untreated. In this study, the most widely used technique for cleaning diatoms (hydrogen peroxide method, 30% H_2O_2 solution) was applied. First, formaldehyde was removed: samples were homogenised by shaking, placed in a tube, and centrifuged (at 2500 rpm for 15 min), the supernatant was removed and made up with distilled water. This procedure was repeated three times. Then, a few drops of hydrogen peroxide were very carefully added to the pellet and heated on a hot plate at about 90 °C for 2 h until the brownish suspension stopped becoming whitish. Then a few drops of HCl were added and the centrifugation process was repeated according to the previously described method to remove all the hydrogen peroxide. A few drops of the purified diatoms were placed on a coverslip and allowed to dry. After an appropriate number of diatoms were placed on the coverslip (control performed), a small drop of Naphrax® high refractive index medium (RI = 1.74) was placed on a slide and the coverslip was placed over it. The preparation was heated for approximately one minute until no bubbles appeared. Three replicate preparations were made for each sample. At least 400 valves were counted in each sample, the proportion of each species was measured, and photo documentation was made.

Diatom morphometry was determined by measuring the length and width of at least 20 individuals using light microscopes (LM): Leicka DMLB at Chengdu Institute of Biology, Chinese Academy of Science and Olympus BX51 microscope equipped with Differential Interference Contrast (Nomarski) optics at Faculty of Sciences, Department of Biology at University of Zagreb.

Diatom morphometrics was determined by measuring the length and width of at least 20 individuals using light microscopes (LM): Leicka DMLB at the Chengdu Institute of Biology, Chinese Academy of Science and Olympus BX51 microscope with Differential Interference Contrast (Nomarski) optics at the Faculty of Sciences, Department of Biology, University of Zagreb. For scanning electron microscopy (SEM), part of the suspension was filtered on polycarbonate membranes (Millipore®) with a maximum pore diameter of 3 mm, pieces of which were fixed on aluminium rods after drying in air. The rods were sputter coated with 50 nm gold and examined in a JEOL-5800LV at 20 kV. Transmission electron microscopy was performed using a scanning electron microscope (Tescan Mira 3 SEM) at the *Ivan Vučetić* Croatian Centre for Forensic Science to accurately identify some diatom species.

The consistent identification of the diatoms described in this book is a prerequisite for the study of their ecology, biogeography, and their successful application as environmental indicators. The analyses conducted identified 263 diatom species (plates: A–G and 1–131) belonging to 69 genera. All listed species were photographically documented (LM = 3702 and SEM = 12 photos) and described in detail.

The genus Navicula dominates with the highest number of species (20 species), followed by the genera: Fragilaria & Cymbella (19 species each), Nitzschia (15 species), Cymbopleura (14 species) and Gomphonema (12 species), while the remaining genera are represented by less than 10 species.

Of the total number of species, 10.6% or 28 species receive the potential designation sp. nov., but more detailed analyses are needed for final confirmation, the results of which will be published in subsequent scientific papers. For example, in the genus Fragilaria, six species were noted, while in other 14 genera (Achnanthidium, Adlafia, Brachysira, Cymbopleura, Cymbellafalsa, Cymbella, Diploneis, Distrionella, Delicata, Gomphonella, Gomphonema, Odontidium, Sellaphora, Stauroneis) one to three is listed as potentially new species.

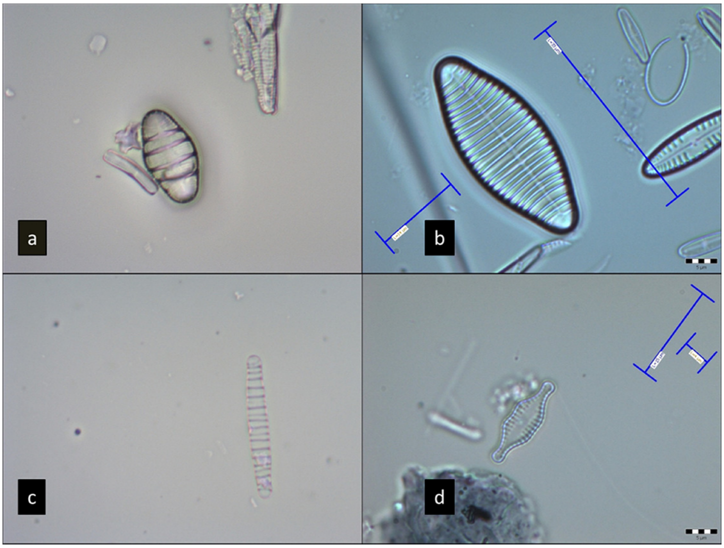

Plate A – LM microscope photographs of some araphid diatoms from Jiuzhaigou: a = *Odontidium mesodon* (Ehrenberg) Kützing, b = *Diatoma vulgaris* Bory, c = *Diatoma moniliformis* Kützing, d = *Fragilaria parasitica* var. *subconstricta* Grunow (a–d scale bar = 5 μm).

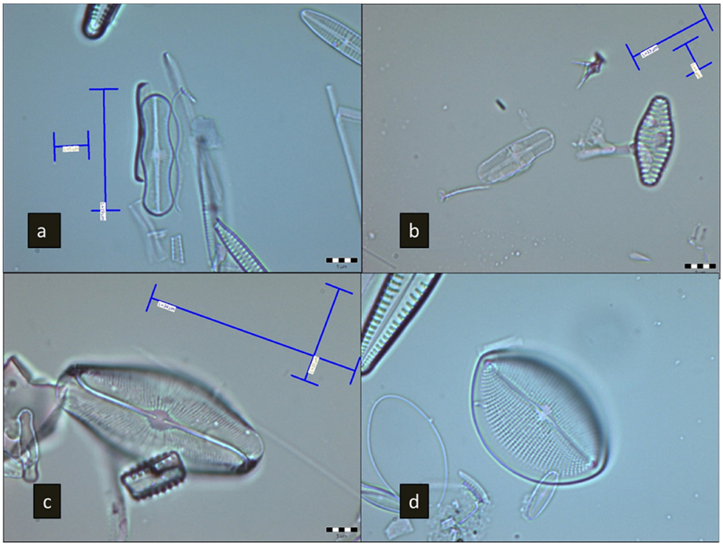

Plate B – LM microscope photographs of some monoraphid diatoms from Jiuzhaigou: a = *Achnanthes trinodis* (Ralfs) Grunow, b = *Achnanthidium rosenstockii* Lange-Bertalot, c = *Eucocconeis flexell*a (Kützing) Meister, d = *Cocconeis pediculus* Ehrenberg (a–d scale bar = 5 μm).

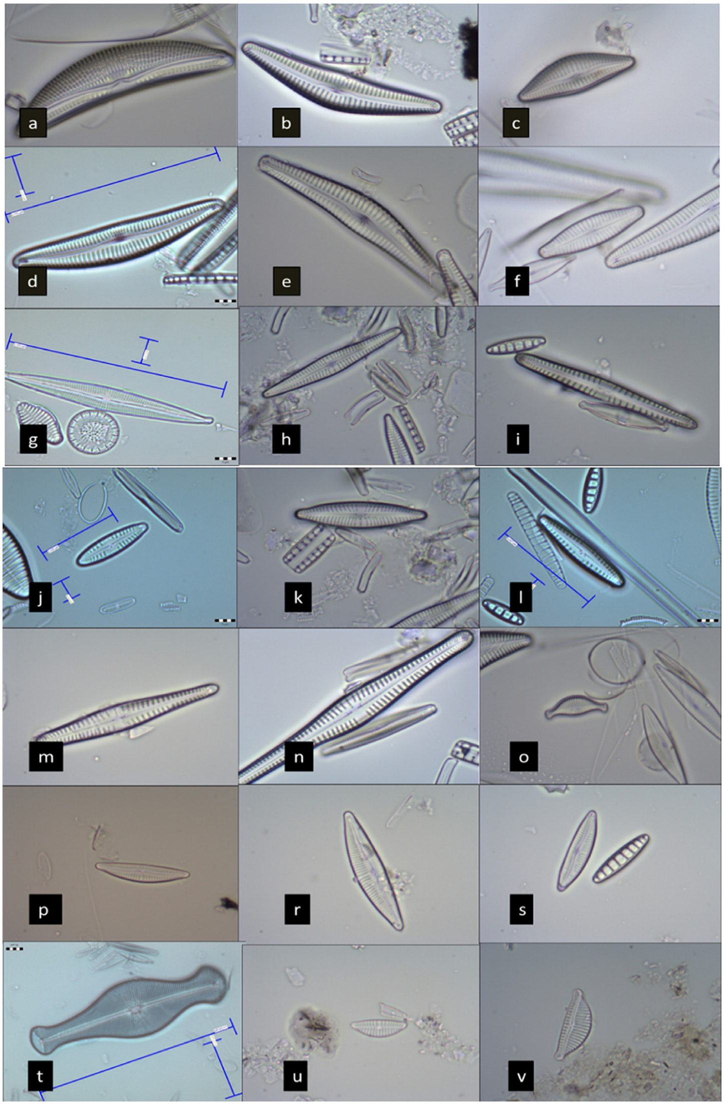

Plate C – LM microscope photographs of some asymmetrical biraphid diatoms from Jiuzhaigou: a = *Amphora ovalis* (Kützing) Kützing, b = *Cymbella hantzschiana* Krammer, c = *Cymbella hustedtii* Krasske, d = *Cymbella lange-bertalotii* Krammer, e = *Cymbella vulgata* Krammer, f = *Cymbopleura subequalis* (Grunov) Krammer, g = *Encyonopsis cesatii* (Rabenhorst) Krammer, h = *Gomphonema auritum* A. Braun ex Kützing, i = *Gomphonema lateripunctatum* E. Reichardt, j = *Gomphonema lateripunctatum* E. Reichardt, k = *Gomphonema micropus* Kützing, l = *Gomphonema* cf. *pumilum*, m & n = *Gomphonema vibrio* Ehrenberg, o = *Halamphora thumensis* (A. Mayer) Levkov, p = *Delicata* cf. *sparsistriata*, r = *Delicata delicatula* (Kütz.) Krammer, s = *Delicata sinensis* Krammer & Metzeltin, t = *Didymosphenia geminata* (Lyngbye) M. Schmidt, u, v = *Encyonema ventricosum* (C. Agardh) Grunow, (a–v scale bar = 5 μm).

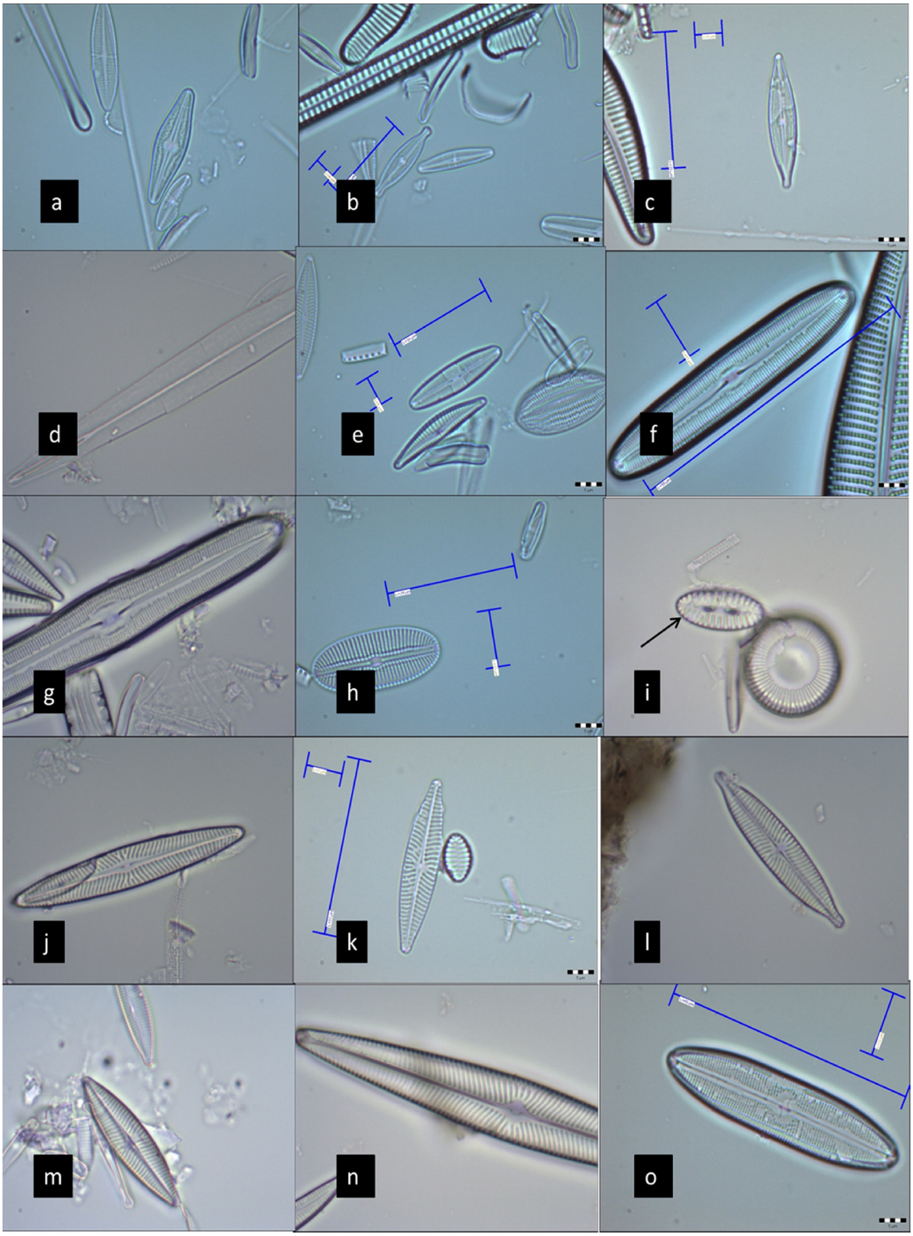

Plate D – LM microscope photographs of some symmetrical biraphid diatoms from Jiuzhaigou: a = *Brachysira* cf. *brebissonii*, b = *Brachysira neoexilis* Lange-Bertalot, c = *Brachysira* cf. *neglectissima*, d = *Amphipleura pellucida* (Kützing) Kützing, e = *Caloneis lancettula* (E. Schulz) Lange-Bert. & Witkowski, f = *Caloneis alpestris* (Grunow) Cleve, g = *Caloneis schumanniana* Krammer & Lange Bertalot, h = *Diploneis* cf. *parma*, i = *Hygropetra* cf. *balfouriana*, j = *Navicula cryptotenella* Lange-Bertalot, k = *Navicula* cf. *hintzii*, l = *Navicula cryptocephala* Kützing, m = *Navicula lundii* E. Reichardt, n = *Navicula radiosa* Kützing, o = *Neidium* sp. (a–o scale bar = 5 μm).

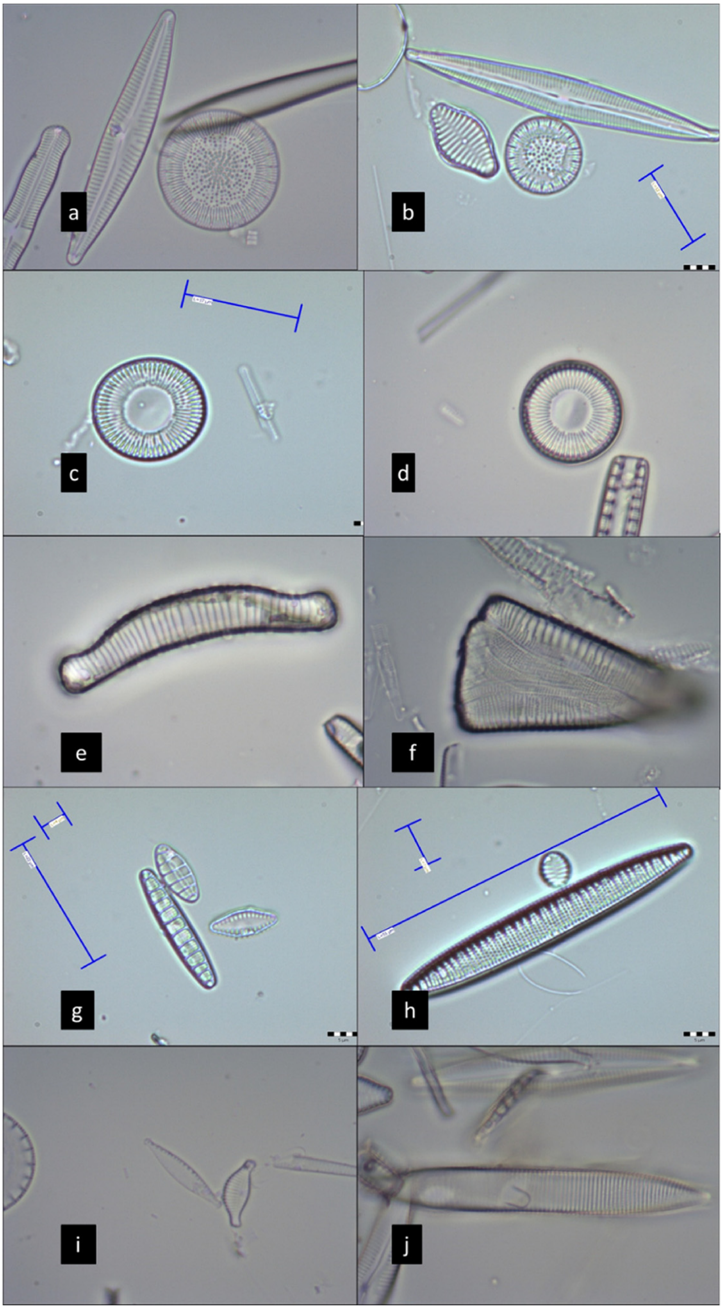

Plate E – LM microscope photographs of some Centric (a, b = *Lindavia radiosa* (Grunow) De Toni & Forti, c, d = *Cyclotella* cf. *distinguenda*), Eunotioid (e = *Eunotia arcubus* Nörpel-Schempp & Lange-Bertalot, f = *Eunotia* sp.; pleural view); and Nitzschoid (g = *Denticula tenuis* Kützing, h = *Nitzschia denticula* Grunow, i = *Nitzschia archibaldii* Lange-Bertalot, j = *Nitzschia angustata* W. Sm.) diatoms from Jiuzhaigou; (a–j scale bar = 5 μm).

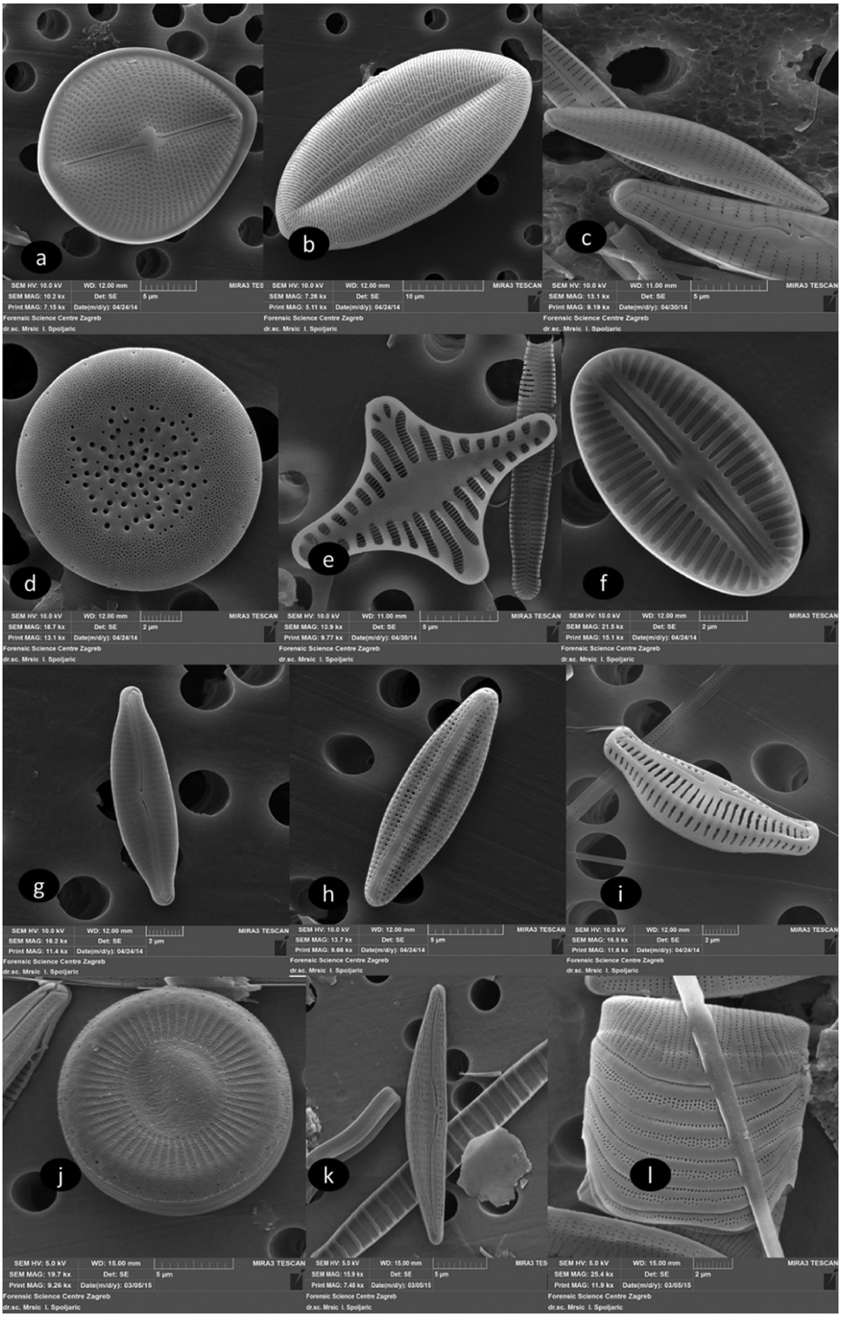

PLATE F – SEM microscope photographs of some diatoms from Jiuzhaigou: a, b = *Cocconeis placentula* Ehrenberg, c = *Delicata delicatula* (Kütz.) Krammer, d = *Puncticulata* sp., e = *Staurosirella leptostauron* (Ehrenberg) D.M. Williams & F.E. Round, f = *Diploneis* sp., g = *Encyonema* sp., h = *Denticula tenuis Kützing*, i = *Halamphora thumensis* (A. Mayer) Levkov, j = *Cyclotella distinguenda* Hustedt, k = *Diatoma moniliformis* Kützing, l = *Eunotia* sp. (girdle view).

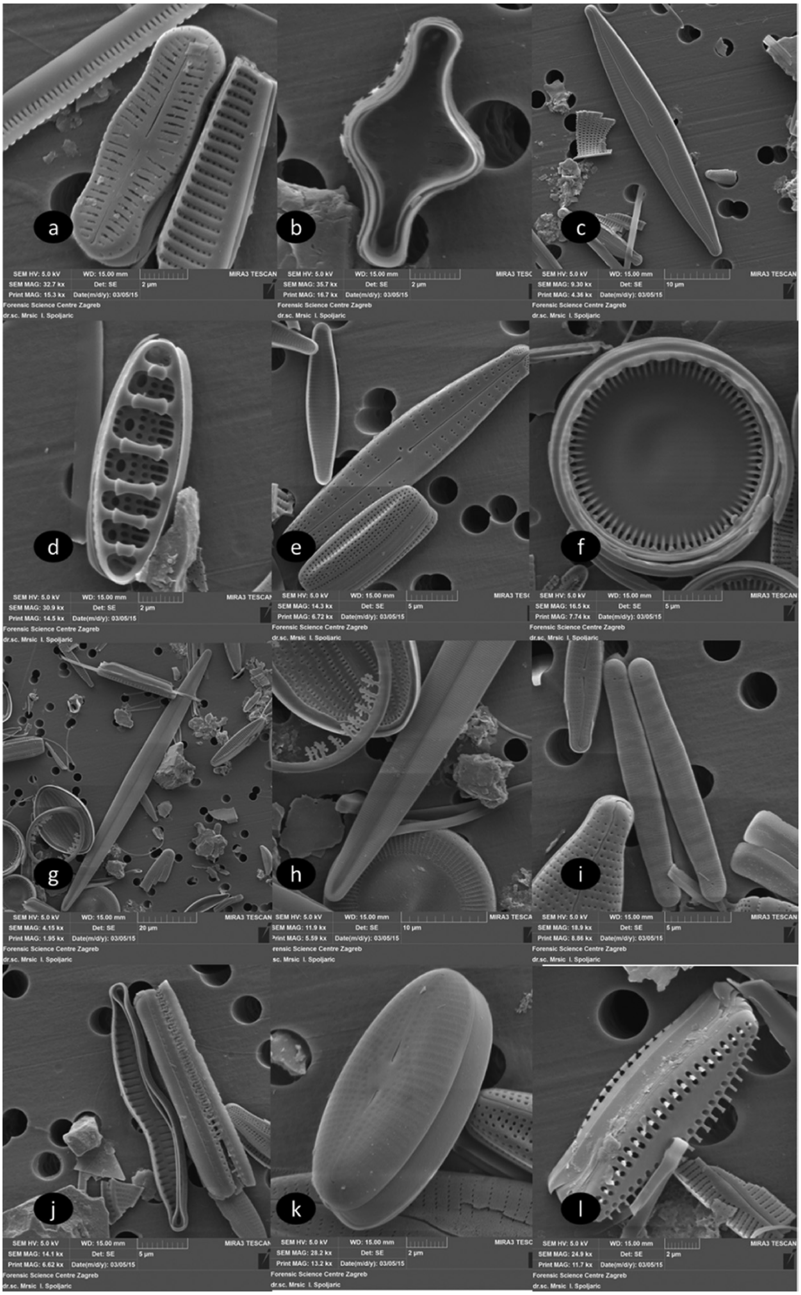

PLATE G – SEM microscope photographs of some diatoms from Jiuzhaigou: a = *Achnanthes trinodis* (Ralfs) Grunow, b = *Staurosirella leptostauron* (Ehrenberg) D.M. Williams & F.E. Round, c = *Delicata delicatula* (Kütz.) Krammer, d = *Gomphonema lateripunctata* Reichardt & Lange-Bertalot, e = *Gomphonema* sp., f = *Cyclotella* cf. *distiguenda*, g–h = *Amphipleura pellucida* (Kütz.) Kützing + detail, i = *Diatoma moniliformis* Kützing, j = *Fragilaria* sp. (deformed), k = *Diploneis separanda* Lange-Bertalot, l = *Pseudostaurosira* sp.

PLATE 1. *Cyclotella distinguenda* Hustedt

Figs 1–23. *Cyclotella distinguenda* Hustedt

Cells are solitary. Valves are circular with a diameter of 7–27 μm. Central area is large, occupying approximately $^1/_3$–$^1/_2$ of the valve diameter, tangentially undulate, with variable degrees of undulation ranging from slight to distinct. Usually, the central area is smooth without ornamentation, but in large specimens, it might be ornamented with granules. Valve face fultoportula in the central area is absent. Striae are short, tapering towards central area. A circular shadow line, appearing as a faint ring, crosses the striae near the valve margin. Striae are composed of 2–5 small circular areolae (visible with SEM). Marginal fultoportulae are numerous and positioned on the valve mantle. One stalked rimoportula is present on the valve mantle.

Cyclotella distinguenda is considered a widely spread (cosmopolitan) species and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–23. Jiuzhaigou National nature reserve, sample Acc. No. 4.

PLATE 2. *Lindavia radiosa* (Grunow) De Toni & Forti

Figs 1–32. *Lindavia radiosa* (Grunow) De Toni & Forti

Cells are solitary and cylindrical. Valves are circular with a diameter of 10.5–28.0 μm. The valve face is concentrically undulated, with a marginal area with striae of equal length. Central area is slight to moderately convex, surrounded by a shallow hyaline depression. Marginal area occupies approximately $^1/_3$–$^1/_2$ of the valve diameter. Valve centre with coarse areolae of equal size that are arranged in a radiated pattern. Every 3–5 interstria (costa) is thickened, about 4–5 in 10 μm. Valve face fultoportulae scattered in the central area. One rimoportula is present at the end of shortened stria. Marginal striae are multiseriate and composed of small round areolae, 14–18 in 10 μm.

Lindavia radiosa is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–32. Jiuzhaigou National nature reserve, sample Acc. No. 67 – 1Ah.

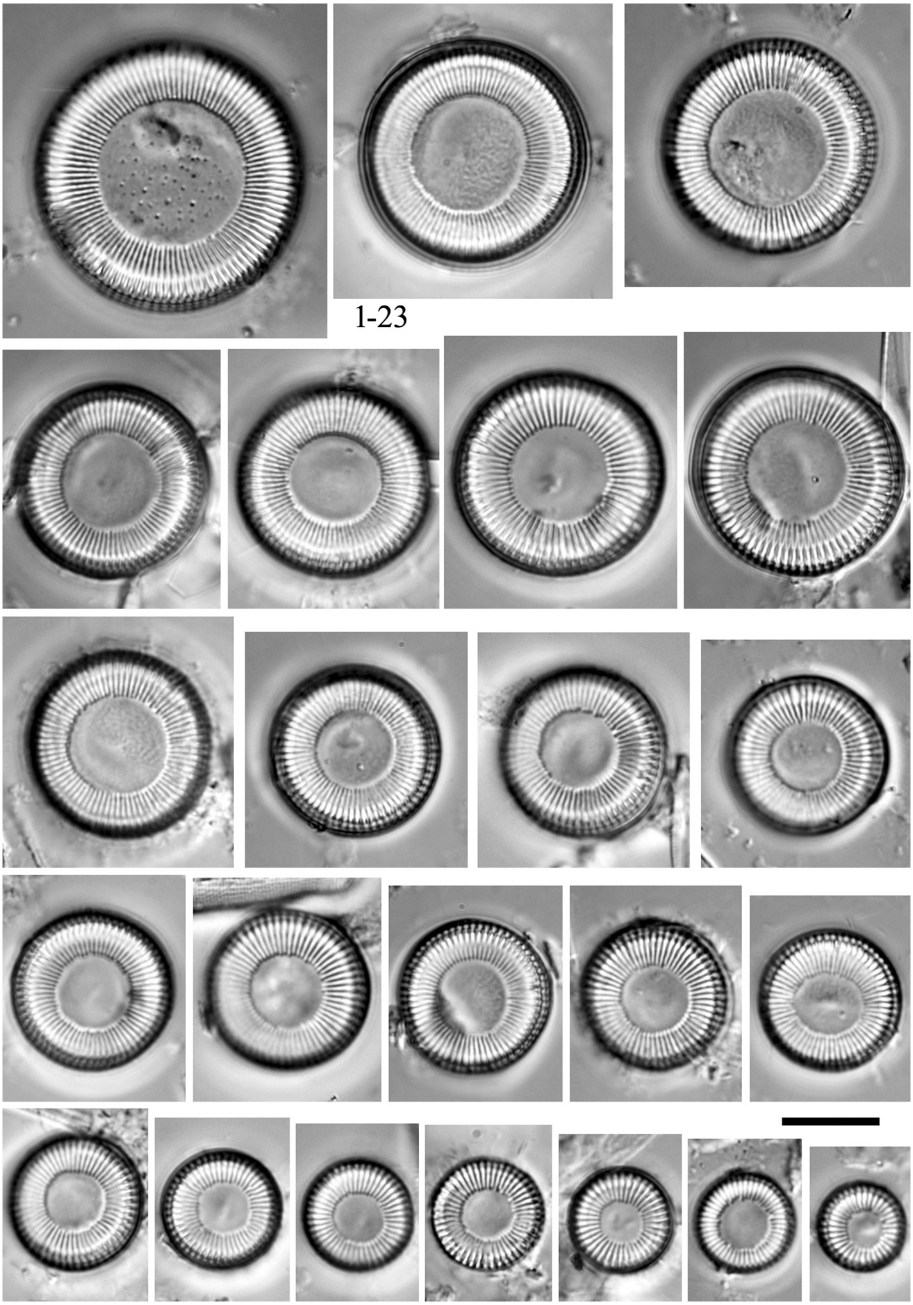

Plate 1 – *Cyclotella distinguenda* Hustedt (1.–23.).

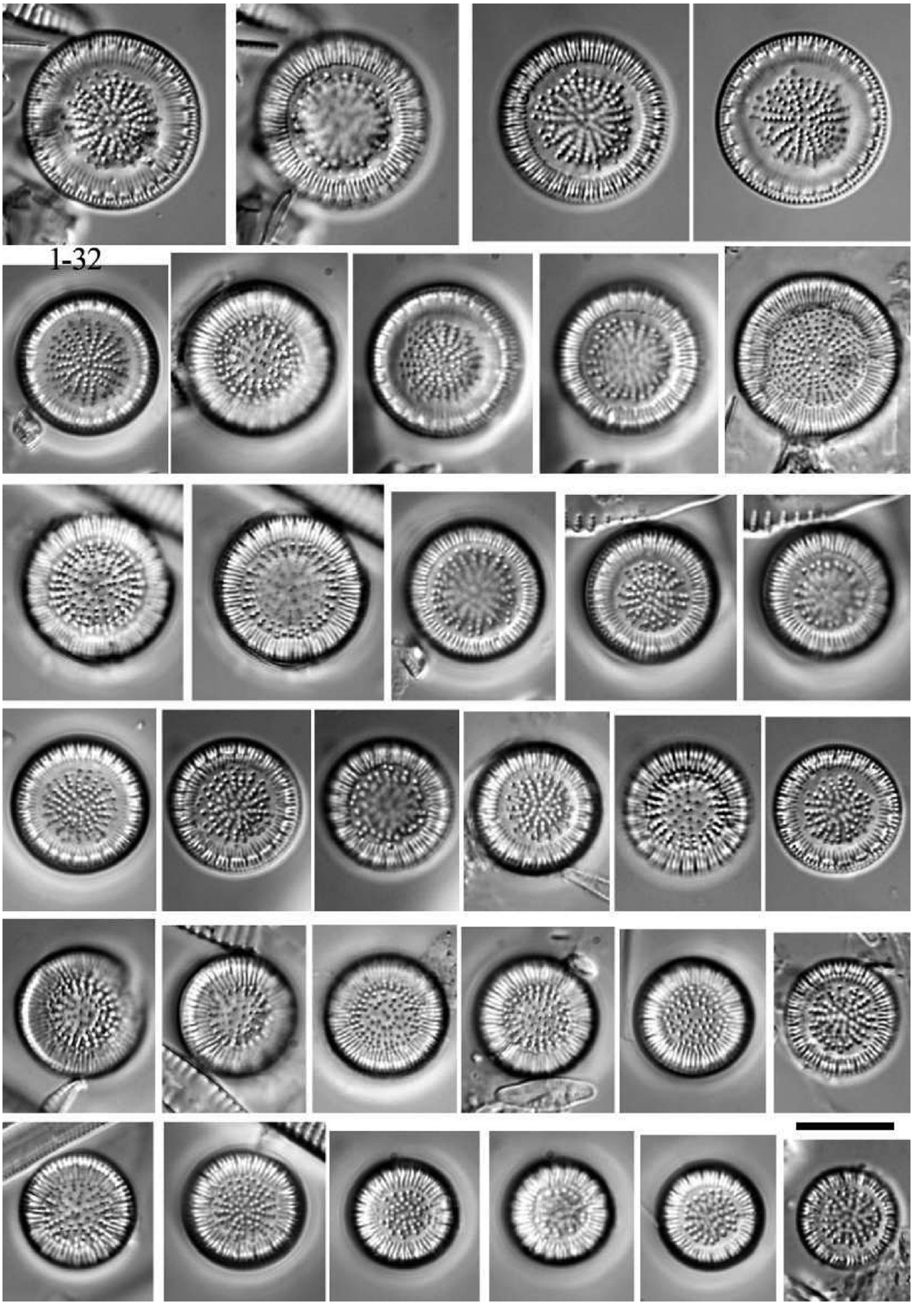

Plate 2 – *Lindavia radiosa* (Grunow) De Toni & Forti (1.–32.).

PLATE 3. *Lindavia khinganensis* Rioual, *Lindavia* sp. aff. *antiqua* (W. Smith) Nakov, Guillory, Julius, Theriot & Alverson, *Orthoseira roeseana* (Rabenhorst) Pfitzer., *Pantocsekiella ocellata* (Pantocsek) K.T. Kiss & Ács, *Stephanodiscus parvus* Stoermer & Håkansson, *Lindavia affinis* (Grunow) Nakov, Guillory, Julius, Theriot & Alverson

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Figs 1–10. *Lindavia khinganensis* Rioual

Cells are solitary and cylindrical. Valves are circular with a diameter of 8.0–19.0 μm. The valve face is slightly concentrically undulated, with a marginal area with striae with unequal length. Central area is slight to moderately convex or concave. Marginal area occupies approximately $^1/_3$–$^1/_2$ of the valve diameter. Valve centre with fine areolae of equal size that are arranged in a radiated pattern. Every 3–5 interstria (costa) is thickened, about 5–7 in 10 μm. Valve face fultoportulae scattered in the central area. One to three rimoportula present at the end of shortened stria. Marginal striae are multiseriate and composed of small round areolae, 14–24 in 10 μm.

Lindavia khinganensis was described from Lake Tuofengling, Greater Khingan Mountain (Rioual *et al.*, 2017) and appears very similar to *L. praetermissa* (Lund) Nakov, Guillory, Julius, Theriot & Alverson. Probably is widely distributed in P.R. China, but confused with other Lindavia species.

Figs 11–16. *Lindavia* sp. aff. *antiqua* (W. Smith) Nakov, Guillory, Julius, Theriot & Alverson

Figs 17–19. *Orthoseira roeseana* (Rabenhorst) Pfitzer

Figs 20–23. *Pantocsekiella ocellata* (Pantocsek) K.T. Kiss & Ács

Valves are circular with a diameter of 8.0–16.0 μm, with a central area occupying $^1/_3$–$^2/_3$ of the valve diameter, surrounded by striae with variable lengths. The central area is ornamented with orbiculi depressi and complementary elevated papillae, 2–6 per valve (usually 3). The central area is often smooth, but it can be colliculate. Striae composed of varying areolae arranged in multiseriate rows. The rows comprise 1–2 radial striae of small areolae between 2 striae composed of larger areolae. One to three valve face fultoportulae is present near the orbicular depressions. Marginal fultoportulae are located on every 4–5 costae. A single rimoportula present on valve face, connected or near the costa.

Fig. 24. *Stephanodiscus parvus* Stoermer & Håkansson

Fig. 25. *Lindavia affinis* (Grunow) Nakov, Guillory, Julius, Theriot & Alverson

Scale bar = 10 μm
LM 1500x

Figs 1–25. Jiuzhaigou National nature reserve, sample Acc. No. 9.

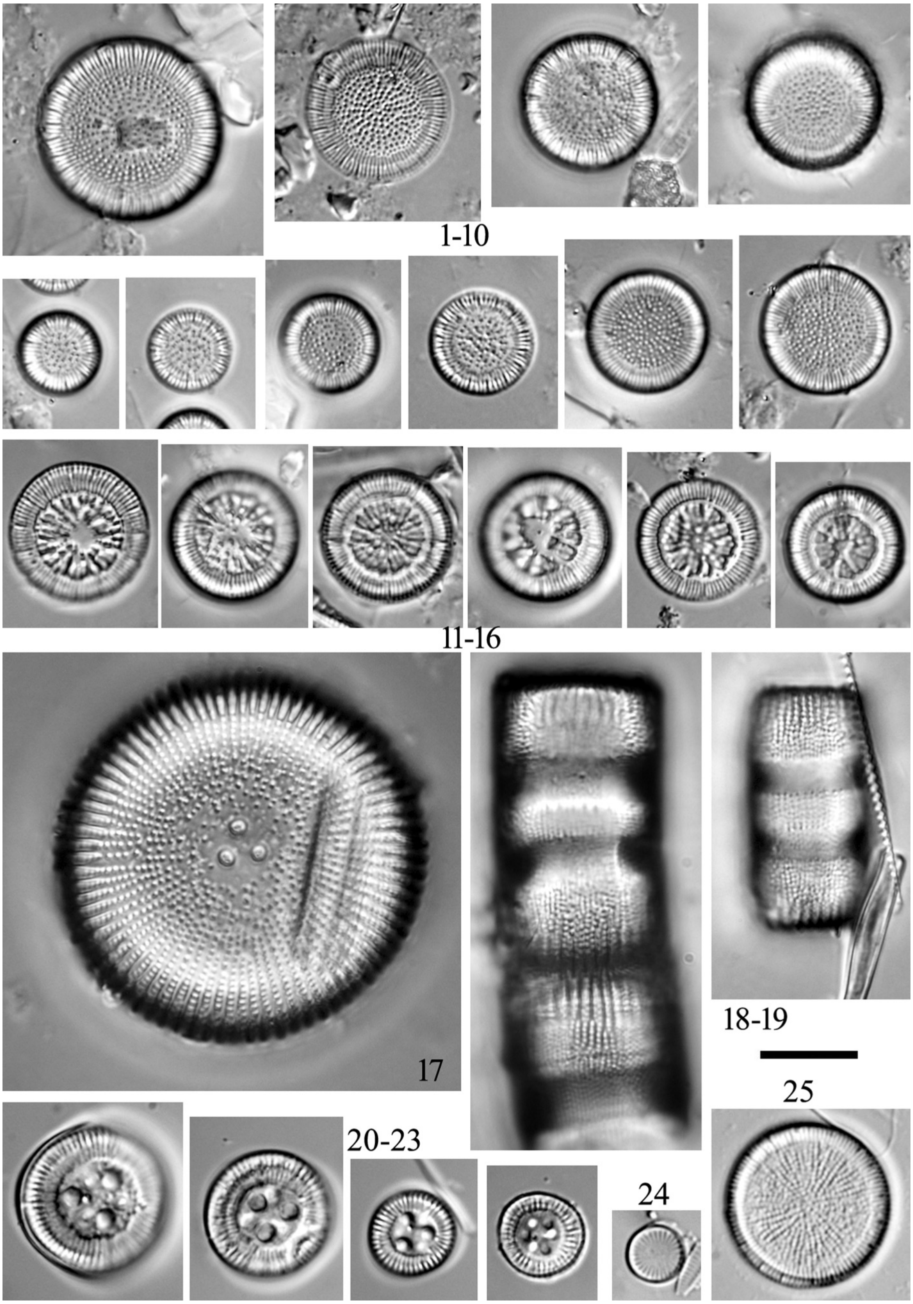

Plate 3 – *Lindavia khinganensis* Rioual (1.–10.), *Lindavia* sp. aff. *antiqua* (W. Smith) Nakov, Guillory, Julius, Theriot & Alverson (11.–16.), *Orthoseira roeseana* (Rabenhorst) Pfitzer. (17.–19.), *Pantocsekiella ocellata* (Pantocsek) K.T. Kiss & Ács (20.–23.), *Stephanodiscus parvus* Stoermer & Håkansson (24.), *Lindavia affinis* (Grunow) Nakov, Guillory, Julius, Theriot & Alverson (25.).

PLATE 4. *Odontidium hyemale* (Roth) Kützing

Figs 1–33. *Odontidium hyemale* (Roth) Kützing

Frustules are rectangular in girdle view. Valves are linear to linear-lanceolate with margins gradually tapering to rounded poles. Small valves are elliptic-lanceolate to elliptic. Valve length varies from 9–40 μm, width 6.0–8.5 μm, length to width ratio 2.5–4.5. Valve face with several rows of spines (spinules) located on valve face and margin. Irregular sternum is present in the mid-valve, $^1/_5$–$^1/_4$ of valve width, extending to the apical pore field. Transapical ribs nearly all are primary, perpendicular, or at a slight angle to the sternum, 3–5 in 10 μm. Striae between ribs appear parallel or at a slight angle, 2–8 rows between pairs of ribs, composed of small round areolae. Cingulum is composed of many bands. A single rimoportula is present with variable location, from centre of the valve face to adjacent to pore fields. Distinct apical pore field is present at each pole. *Odontidium hyemale* is considered a widely spread (cosmopolitan) species and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Recently one new species was described as *Diatoma rupestris* Y. Liu & Q.X. Wang (Liu *et al.*, 2010) and later transferred to the genus Odontidium as *Odontidium rupestris* (Y. Liu & Q.X. Wang) I. Jüttner & D.M. Williams (in Jüttner *et al.*, 2017).

Scale bar = 10 μm
LM 1500x

Figs 1–33. Jiuzhaigou National nature reserve, sample Acc. No. 71 – 5H.

PLATE 5. *Odontidium mesodon* (Ehrenberg) Kützing

Figs 1–52. *Odontidium mesodon* (Ehrenberg) Kützing

Frustules are rectangular in girdle view. Valves are elliptic-lanceolate, rhombic-lanceolate to elliptic with margins gradually tapering to the rounded poles. Valve length varies from 8–16 μm, width 5.5–7.5 μm, length to width ratio 1.5–2.5. Valve face with several rows of spines (spinules) located on valve face and margin. Irregular narrow sternum is present in the mid-valve, $^1/_6$–$^1/_5$ of valve width, extending to the apical pore field. Transapical ribs nearly all are primary, perpendicular, or at a slight angle to the sternum, 3–5 in 10 μm. Striae between ribs appear parallel or at a slight angle, 2–8 rows between pairs of ribs, composed of small round areolae. Cingulum is composed of many bands. A single rimoportula is present near the pole, with variable locations, from centre of valve face to adjacent to pore fields. Distinct apical pore field is present at each pole.

Odontidium mesodon is considered a widely spread (cosmopolitan) species and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–52. Jiuzhaigou National nature reserve, sample Acc. No. 42.

PLATE 6. *Odontidium* sp. 1. nov., *Meridion circulare* (Greville) C. Agardh

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Figs 1–26. *Odontidium* sp. 1. nov.

Frustules are rectangular in girdle view. Valves are linear to linear-lanceolate, with almost parallel margins and narrowly rounded poles. Valve length varies from 9.5–20 μm, width 5.0–6.0 μm, length to width ratio 1.5–3.5. Valve face with several rows of spines (spinules) located on valve face and margin. Irregular narrow sternum is present in the mid-valve, $^1/_6$–$^1/_5$ of valve width, extending to the apical pore field. Transapical ribs nearly all are primary, perpendicular, or at a slight angle to the sternum, 4–6 in 10 μm. Striae between ribs appear parallel or at a slight angle, 5–8 rows between pairs of ribs, composed of small round areolae. Cingulum is composed of many bands. A single rimoportula is present near the pole, with variable location, from centre of valve face to adjacent to pore fields. Distinct apical pore field is present at each pole.

Odontidium sp. 1 is rare species in the study area and it was observed only in one sample from Jiuzhaigou National nature reserve, together with *O. neolongissimum.*

Figs 27–38. *Meridion circulare* (Greville) C. Agardh

Frustules are clavate in girdle view and form fan-shaped colonies. Valves are asymmetric to the transapical axis, clavate to linear clavate. Valve length varies from 15–52 μm, and valve width is 3.5–5.5 μm. Transapical ribs nearly all primary are present and run transversely across the valves. Transapical ribs are wider and coarser towards the headpole, and narrow to almost absent towards the foot pole. A narrow sternum is present in the mid-valve running throughout entire valve. A single rimoportula is present, located near the headpole with variable position. In some specimens a narrow septum is present. Distinct apical pore field is present only on footpole.

Meridion circulare is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–38. Jiuzhaigou National nature reserve, sample Acc. No. 71 – 5H.

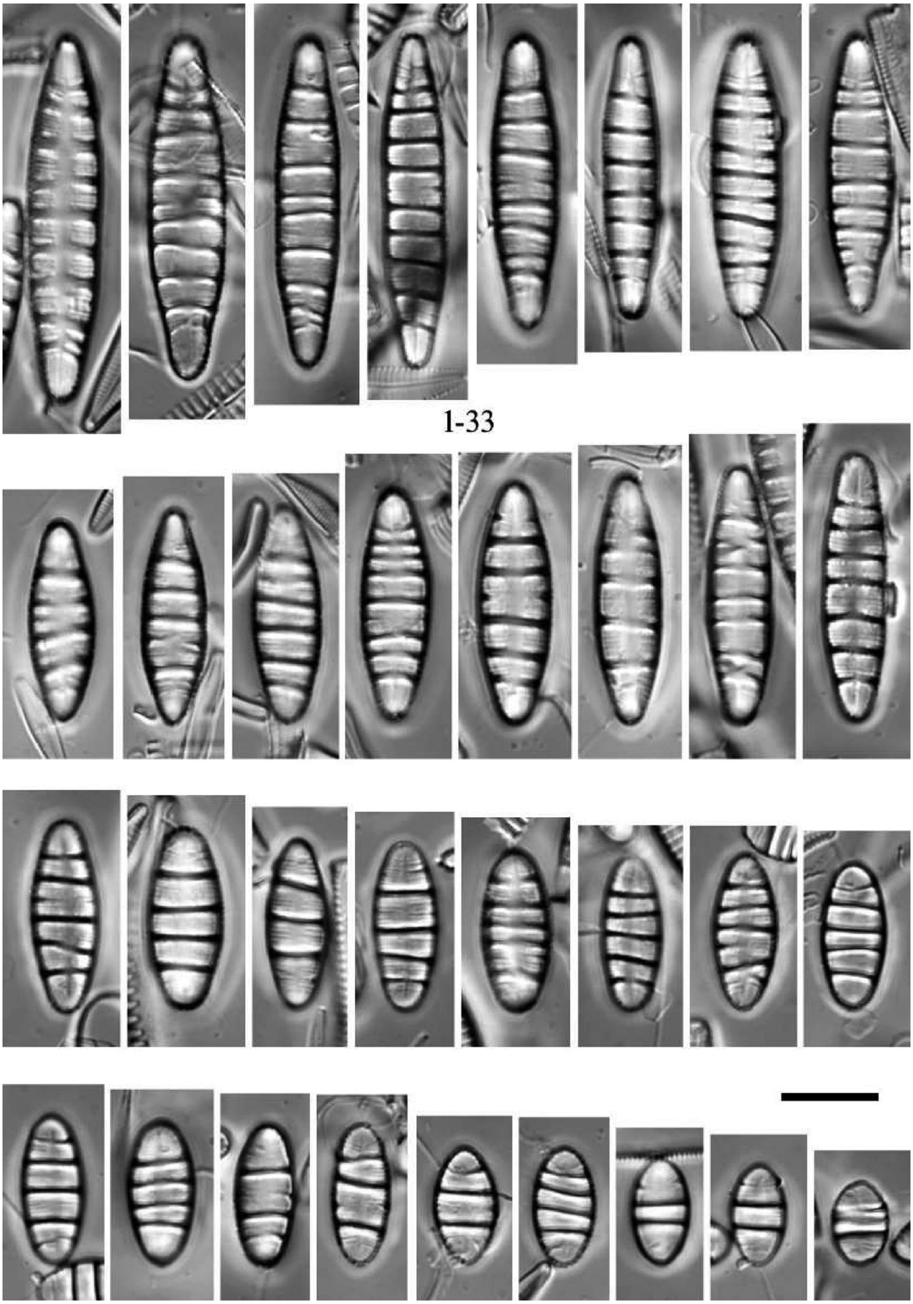

Plate 4 – *Odontidium hyemale* (Roth) Kützing (1.–33.).

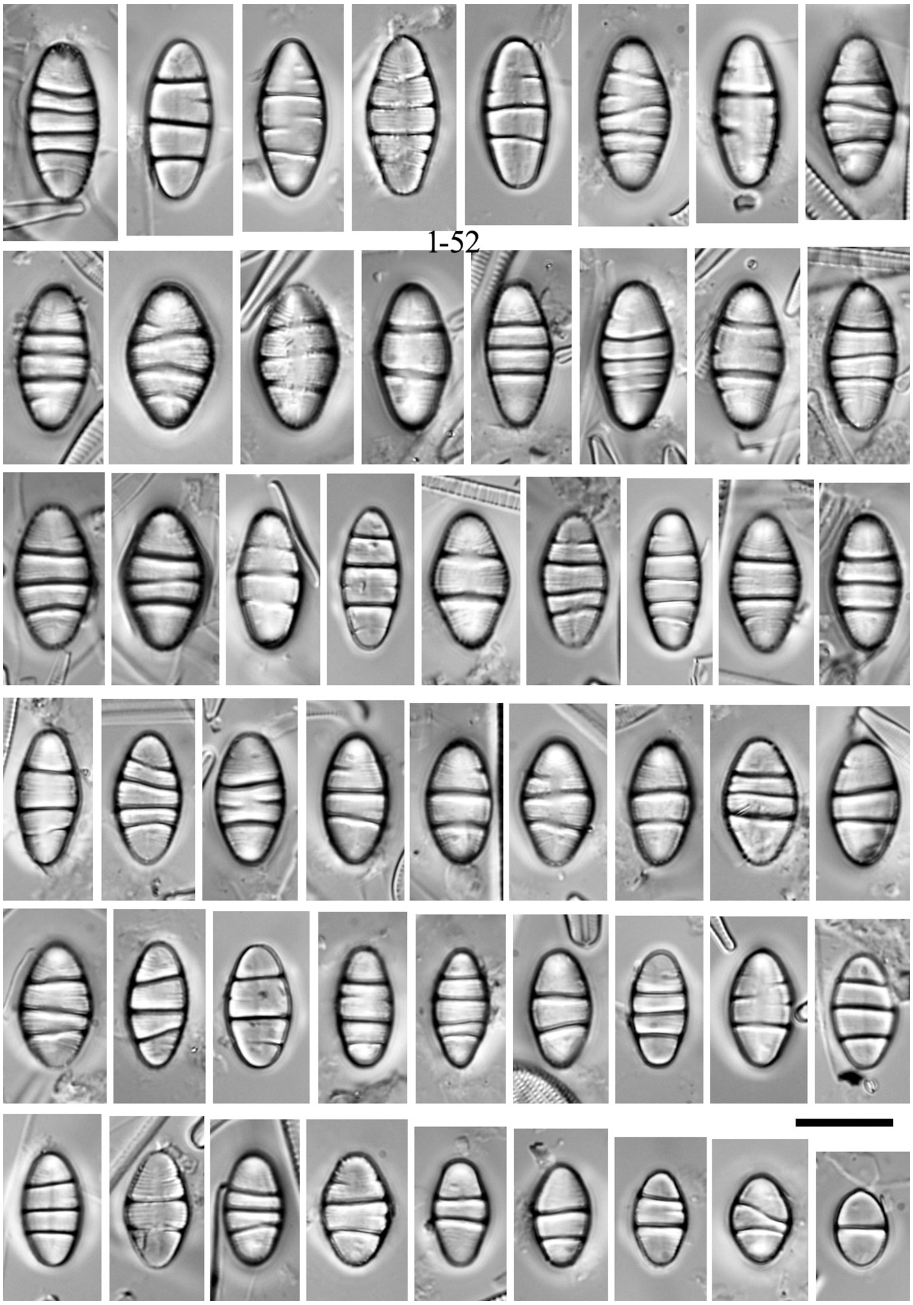

Plate 5 – *Odontidium mesodon* (Ehrenberg) Kützing (1.–52.).

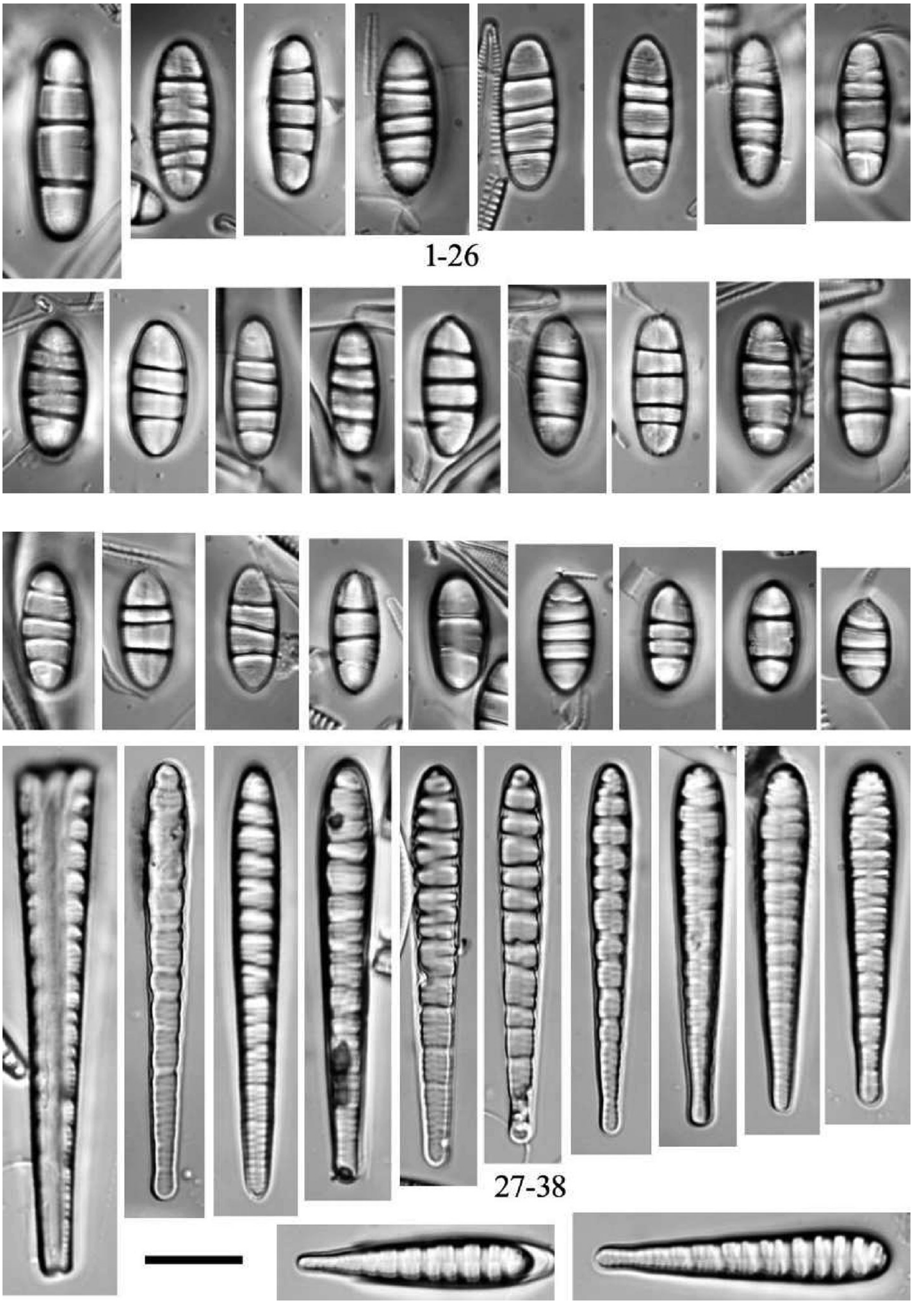

Plate 6 – *Odontidium* sp. 1. nov. (1.–26.), *Meridion circulare* (Greville) C. Agardh (27.–38.).

PLATE 7. *Diatoma vulgaris* Bory

Figs 1–17. *Diatoma vulgaris* Bory

Frustules are rectangular in girdle view and form zig-zag colonies. Valves are broadly lanceolate, elliptic-lanceolate to rhombic-lanceolate. Valve length varies from 30–40 μm, valve width is 9.5–15.0 μm. Transapical ribs are narrow, and primary, secondary, and tertiary ribs are present, running transversely across the valve. Transapical ribs 6–9 in 10 μm. Striae uniseriate, 45–55 in 10 μm, consisted of small round areolae. A narrow sternum is present in the mid-valve running throughout entire valve. A single rimoportula is present, located near the headpole with a variable position. Distinct apical pore field is present only on both poles.

Diatoma vulgaris is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–17. Jiuzhaigou National nature reserve, sample Acc. No. 42.

PLATE 8. *Diatoma moniliformis* Kützing

Figs 1–41. *Diatoma moniliformis* Kützing

Frustules are rectangular in girdle view and form zig-zag colonies. Valves are narrowly lanceolate, to linear-lanceolate. Valve apices variable in shape, not protracted, rostrate, subcapitate to capitate. Valve length varies from 18–37 μm, valve width is 3.5–5.0 μm. Transapical ribs are coarse, mostly primary and secondary, running transversely across the valve. Transapical ribs 7–11 in 10 μm. Striae uniseriate, 50–60 in 10 μm, consisted of small round areolae. A very narrow sternum is present in the mid-valve running throughout entire valve. Two rimoportulae are present, located near the headpole and connected with primary rib. Distinct apical pore field is present only on both poles.

Diatoma moniliformis is considered a widely spread (cosmopolitan) species and it was one of the most frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–41. Jiuzhaigou National nature reserve, sample Acc. No. 1.

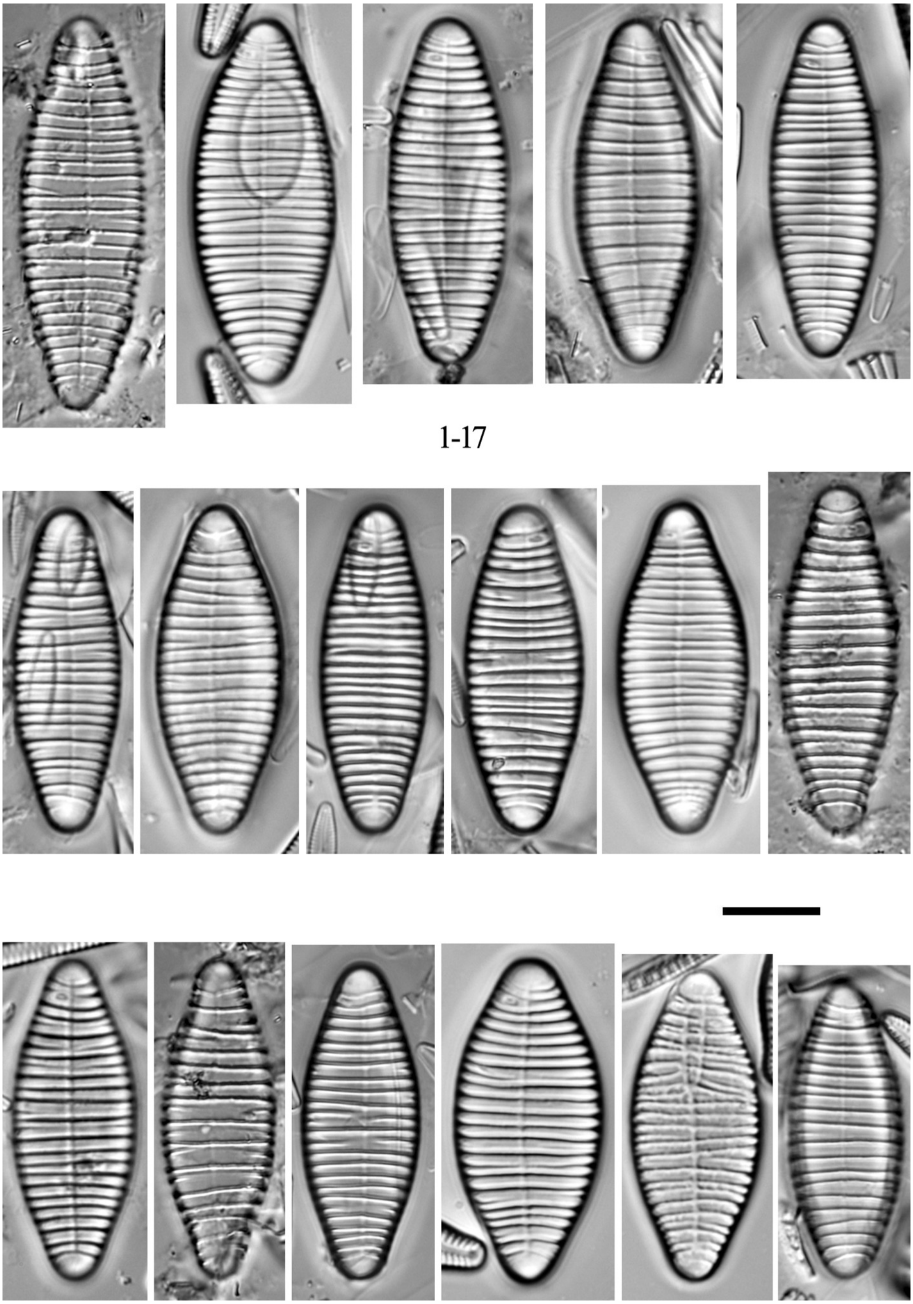

Plate 7 – *Diatoma vulgaris* Bory (1.–17.).

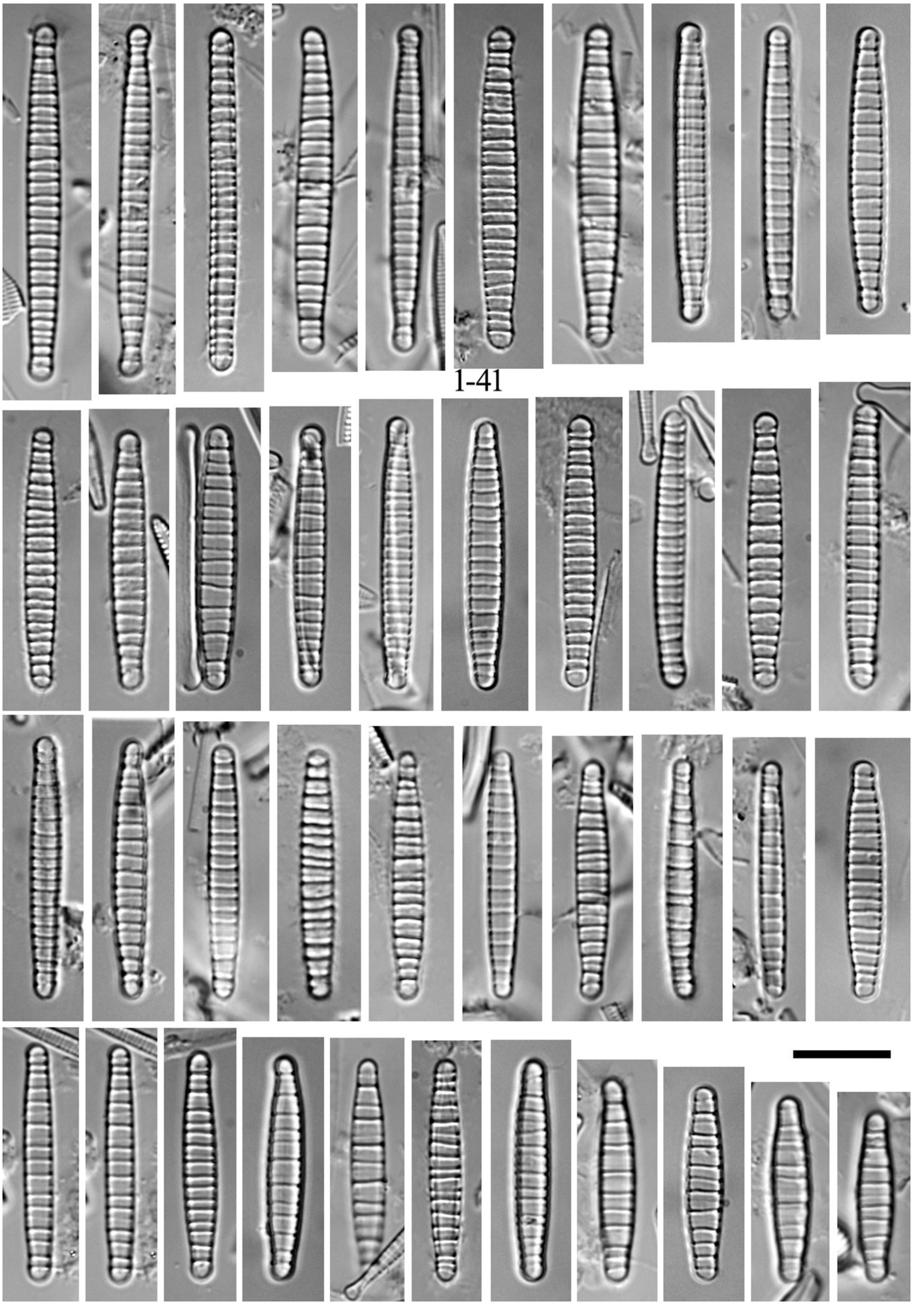

PLATE 8 – *Diatoma moniliformis* Kützing (1.–41.).

PLATE 9. *Distrionella* sp. 1. nov.

Figs 1–39. *Distrionella* sp. 1. nov.

Frustules are narrow, rectangular in girdle view. Valves linear to linear-lanceolate with almost parallel margins or slightly tapering to capitate and occasionally slightly heteropolar apices. Valve length varies from 25–57 μm, and valve width is 2.0–3.0 μm. Narrow sternum (axial area) is present at mid-valve. Transapical ribs narrow running transversely across the valve, 12–15 in 10 μm. Apical pore fields are present mainly on the valve mantle and consist of several porelli arranged in regular rows, extending only slightly onto the valve face. A single rimoportula is located within the polar rib. Striae irregularly spaced between transapical ribs. Girdle bands are simple and open. Spines are absent.

Distrionella sp. 1 was so far observed in several samples from Jiuzhaigou National nature reserve. The genus Distrionella is small with only seven taxa so far known, distributed in oligotrophic habitats (Casa *et al.*, 2019; Morales *et al.*, 2005). Species of Distrionella are not common and rarely reported in the literature. Based on available literature, this taxon is different than previously known taxa and probably represents a new species.

Scale bar = 10 μm
LM 1500x

Figs 1–39. Jiuzhaigou National nature reserve, sample Acc. No. 42.

PLATE 10. *Distrionella* sp. 2. nov.

Figs 1–24. *Distrionella* sp. 2. nov.

Frustules are narrow, rectangular in girdle view. Valves linear to linear-lanceolate with almost parallel margins or slightly tapering to capitate and occasionally slightly heteropolar apices. Valve length varies from 45–74 μm, and valve width 2.0–2.5 μm. Narrow sternum (axial area) is present at mid-valve. Transapical ribs narrow running transversely across the valve, 8–12 in 10 μm. Apical pore fields are present mainly on the valve mantle and consist of several porelli arranged in regular rows, extending only slightly onto the valve face. A single rimoportula is located within the polar rib. Striae irregularly spaced between transapical ribs. Girdle bands are simple and open. Spines are absent.

Distrionella sp. 2 was so far observed in a few samples from Jiuzhaigou National nature reserve. Based on available literature, this taxon is different than previously known taxa and probably represents a new species.

Scale bar = 10 μm
LM 1500x

Figs 1–24. Jiuzhaigou National nature reserve, sample Acc. No. JP P B2 VII 2016.

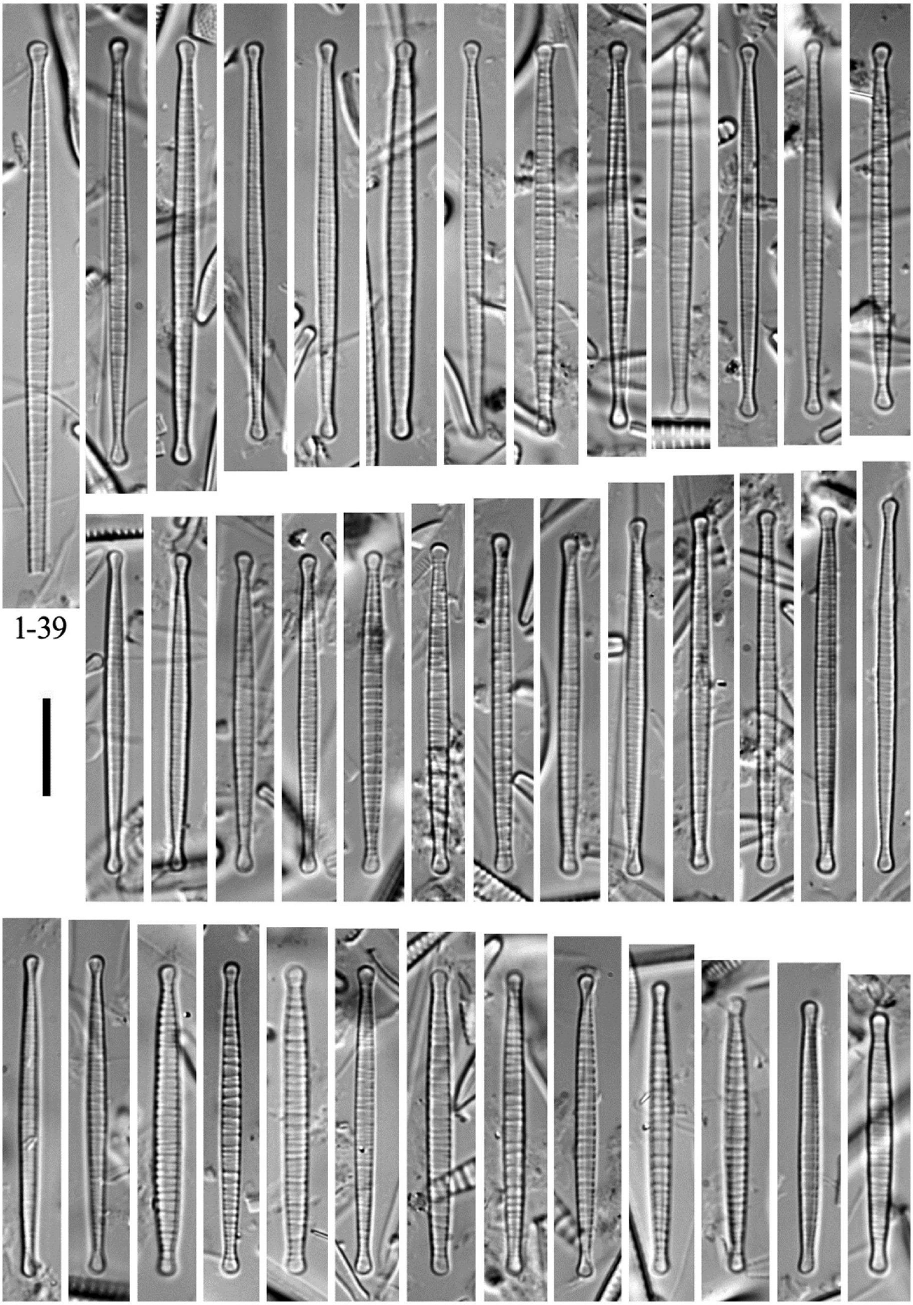

Plate 9 – *Distrionella* sp. 1. nov. (1.–39.).

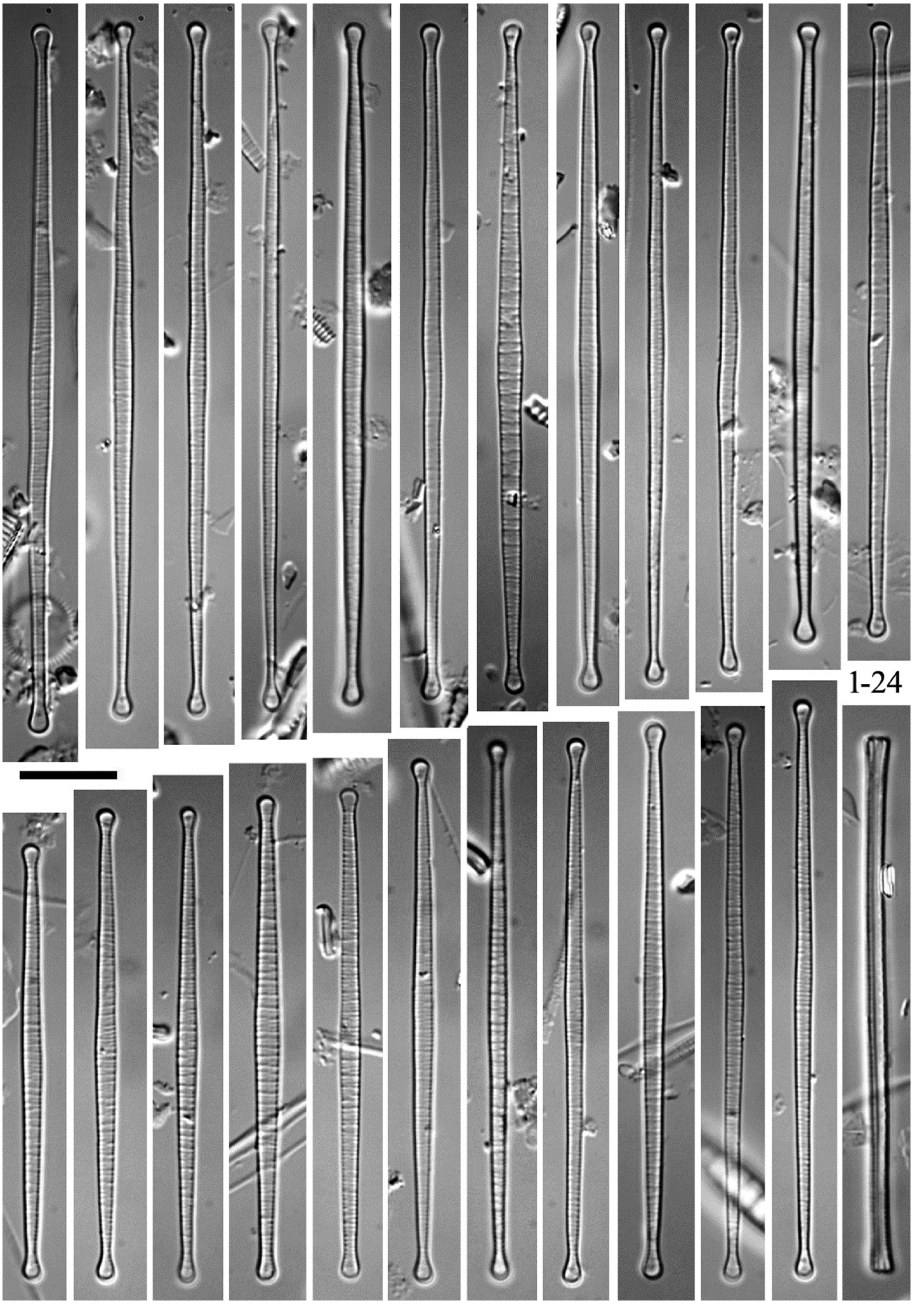

Plate 10 – *Distrionella* sp. 2. nov. (1.–24.).

PLATE 11. *Fragilaria tenera* (W. Smith) Lange-Bertalot

Figs 1–28. *Fragilaria tenera* (W. Smith) Lange-Bertalot

Frustules are narrow, rectangular in girdle view. Valves are very narrow and lanceolate with margins tapering to slightly rostrate to subcapitate apices. Mid- valve slightly convex to almost parallel. Valve length varies from 38–65 μm, and valve width 2.0–2.5 μm. Axial area is narrow, lanceolate, tapering towards central area. Central area variable, indistinct to narrow fascia. Apical pore fields are present on both poles composed of small poroids. A single rimoportula is located near the valve apex. Striae are distinct, but areolae are hardly visible under LM. Striae parallel throughout the valve and extend midway onto the valve mantle. Costae are wider than the striae. Girdle bands are simple and open.

Fragilaria tenera is considered a widely spread (cosmopolitan) species and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–28. Jiuzhaigou National nature reserve, sample Acc. No. 9.

PLATE 12. *Fragilaria* sp. 1. nov.

Figs 1–23. *Fragilaria* sp. 1. nov.

Frustules are narrow, rectangular in girdle view. Valves narrow, lanceolate with margins tapering to slightly rostrate apices. Mid-valve is slightly convex. Valve length varies from 50–75 μm, and valve width is 2.5–3.5 μm. Axial area is narrow, with lanceolate widening towards valve centre. Central area absent. Apical pore fields are present on both poles composed of small poroids. A single rimoportula is located near the valve apex. Striae are distinct, but areolae are hardly visible under LM. Striae parallel throughout the valve and extend midway onto the valve mantle, 16–18 in 10 μm. Costae are wider than the striae. Girdle bands are simple and open.

Fragilaria sp. 1 was so far observed in a few samples from Jiuzhaigou National nature reserve, and in sample 66 is quite frequent. Based on the available literature, this taxon is different than previously known taxa and probably represents a new species.

Scale bar = 10 μm
LM 1500x

Figs 1–23. Jiuzhaigou National nature reserve, sample Acc. No. 66.

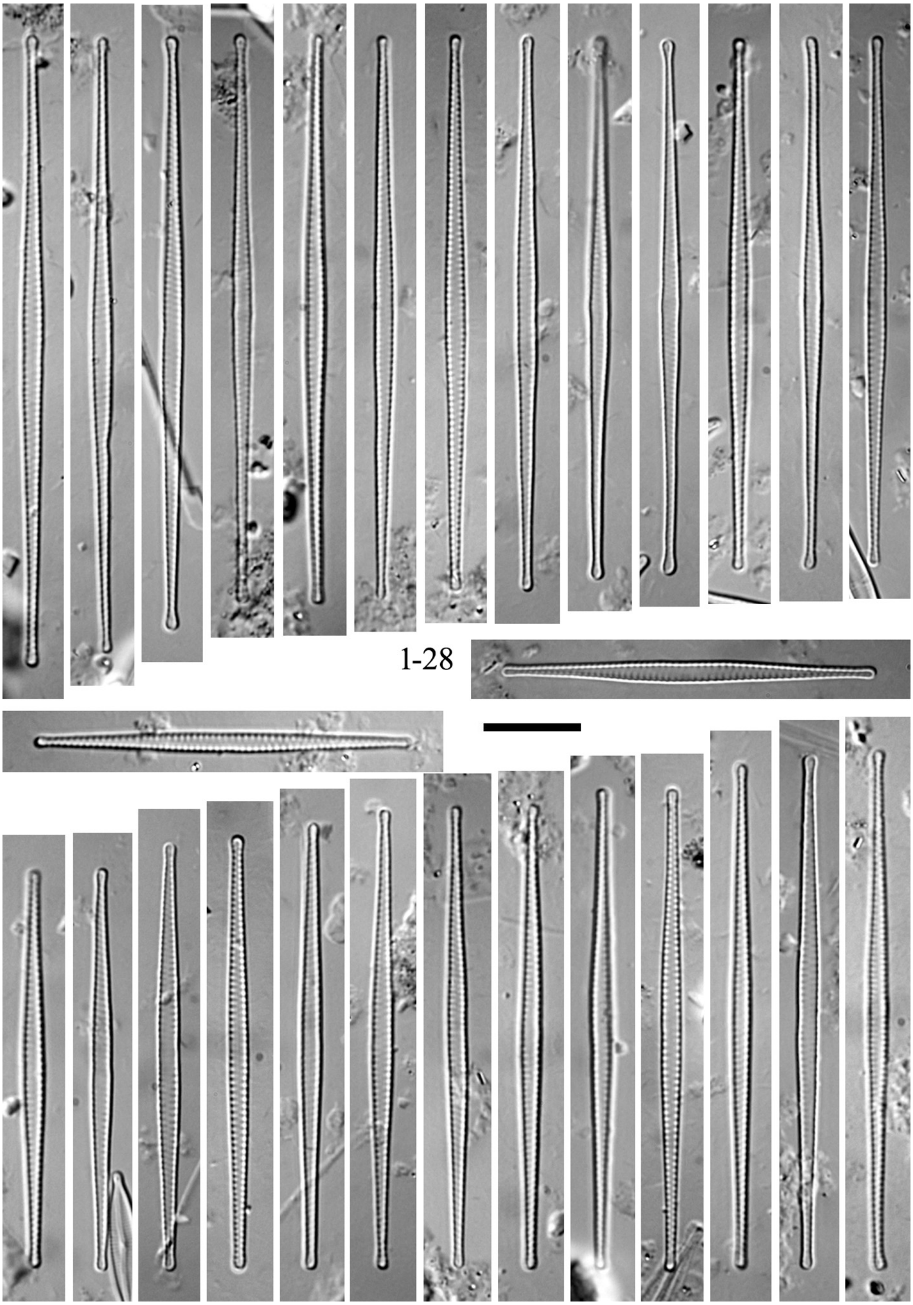

Plate 11 – *Fragilaria tenera* (W. Smith) Lange-Bertalot (1.–28.).

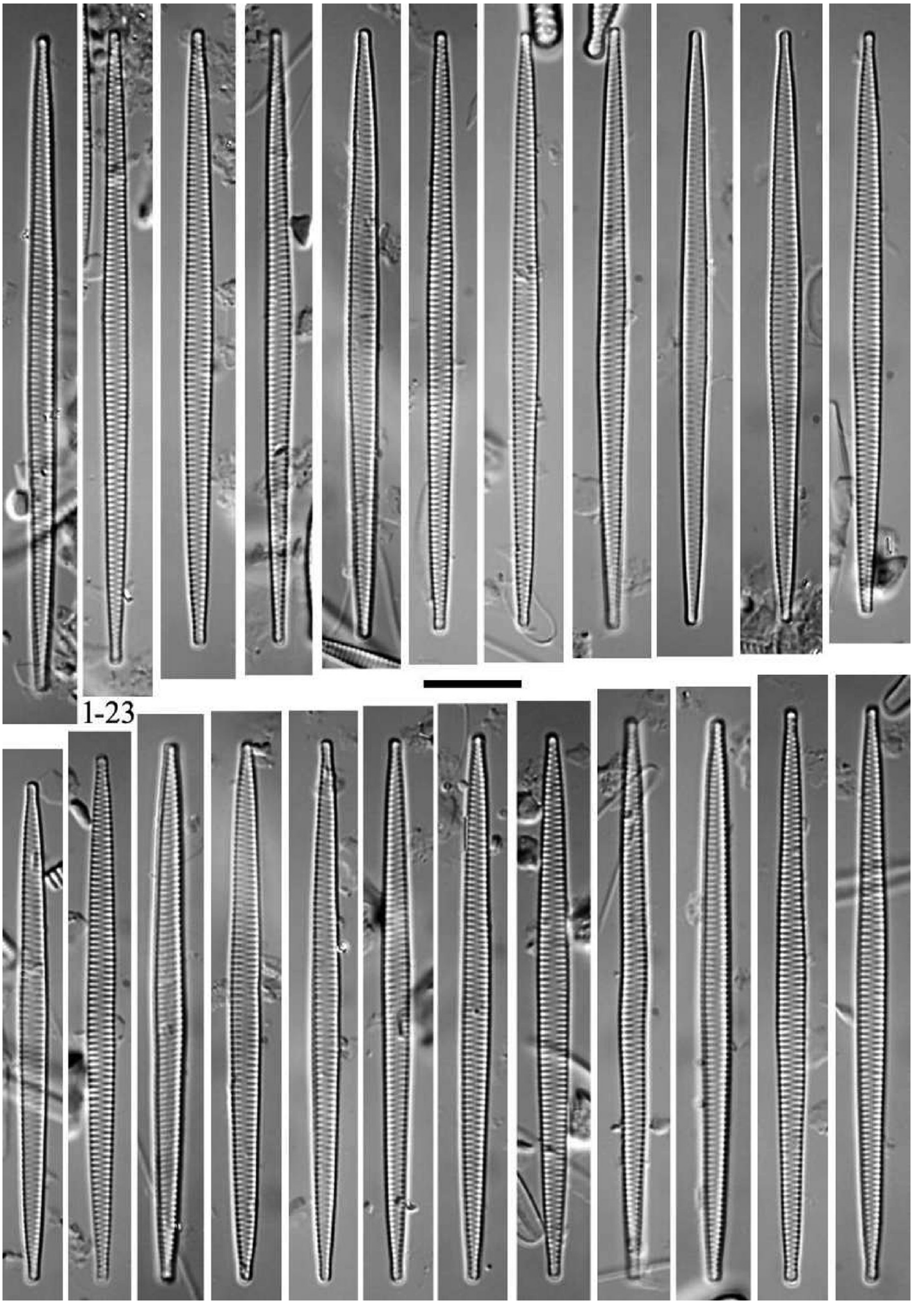

PLATE 12 – *Fragilaria* sp. 1. nov. (1.–23.).

PLATE 13. *Fragilaria perdelicatissima* Lange-Bertalot & Van de Vijver

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Figs 1–27. *Fragilaria perdelicatissima* Lange-Bertalot & Van de Vijver

Frustules are narrow, rectangular in girdle view. Valves lanceolate with margins tapering to rostrate to subcapitate apices. Mid-valve convex. Valve length varies from 31–67 μm, and valve width 2.5–3.5 μm. Axial area is narrow, with lanceolate widening towards valve centre. Central area large fascia, in some specimens "ghost" stria in central area, are present. Apical pore fields are present on both poles composed of small poroids. A single rimoportula is located near the valve apex. Striae are fine, areolae are not visible under LM. Striae parallel throughout the valve and extend midway onto the valve mantle, 16–18 in 10 μm. Costae are wider than the striae. Girdle bands are simple and open.

Fragilaria perdelicatissima is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–27. Jiuzhaigou National nature reserve, sample Acc. No. 42.

PLATE 14. *Fragilaria amphicephaloides* Lange-Bertalot

Figs 1–21. *Fragilaria amphicephaloides* Lange-Bertalot

Frustules are narrow, rectangular in girdle view, forming ribbon-like colonies. Valves linear to slightly linear-lanceolate with almost parallel margins and distinctly capitate apices in larger specimens to long rostrate apices in smaller specimens. Mid-valve parallel. Valve length varies from 33–71 μm, and valve width is 3.0–4.0 μm. Axial area is narrow, linear, and slightly widened near the valve centre. Central area is variable, absent in most of the specimens, to narrow unilateral fascia. Apical pore fields are present on both poles composed of small poroids. A single rimoportula is located near the valve apex. Striae are coarse and widely spaced, areolae are not visible under LM. Striae parallel throughout the valve and extend midway onto the valve mantle, 9–12 in 10 μm. Costae are wider than the striae. Girdle bands are simple and open.

Fragilaria amphicephaloides is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–21. Jiuzhaigou National nature reserve, sample Acc. No. 42.

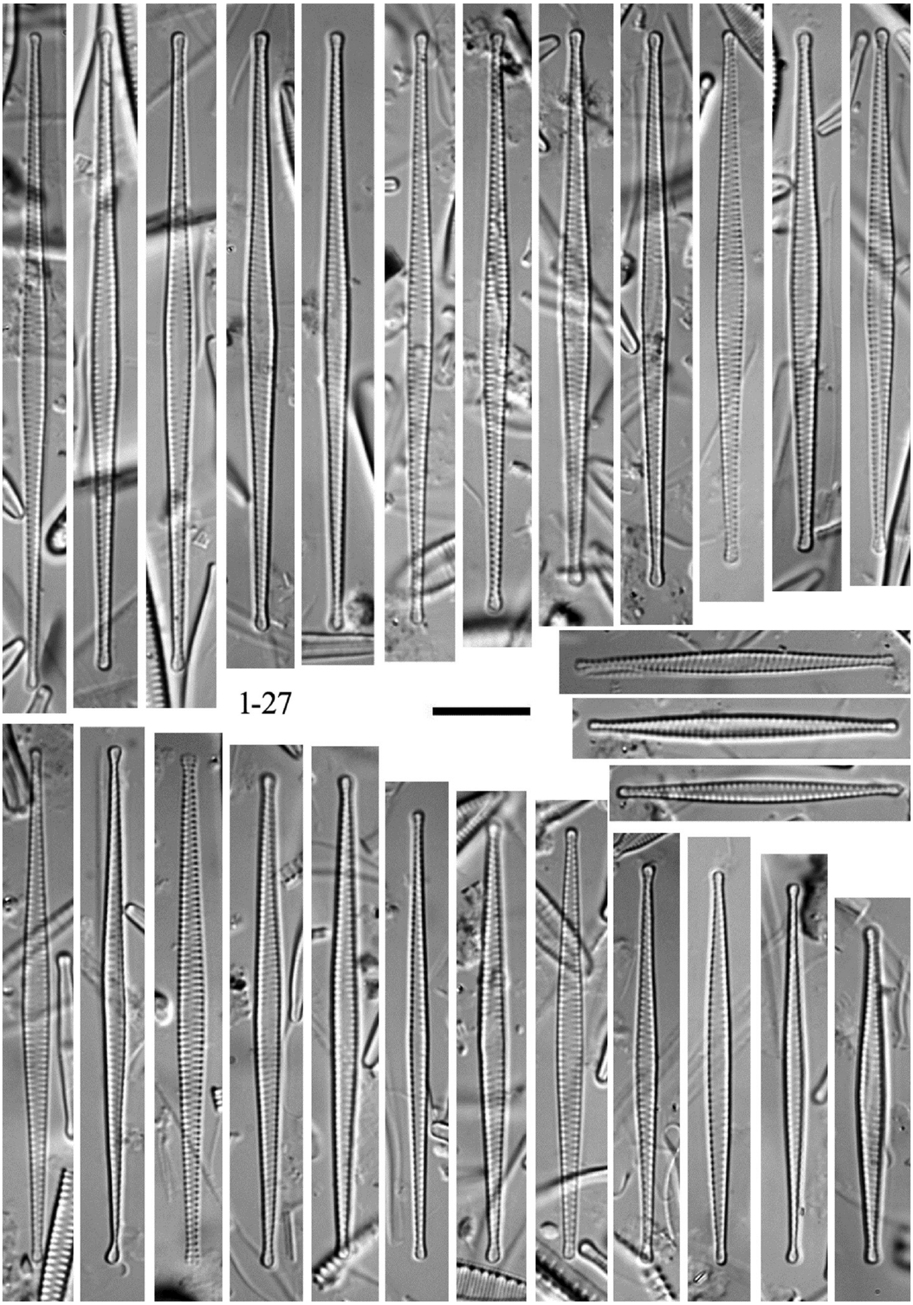

Plate 13 – *Fragilaria perdelicatissima* Lange-Bertalot & Van de Vijver (1.–27.).

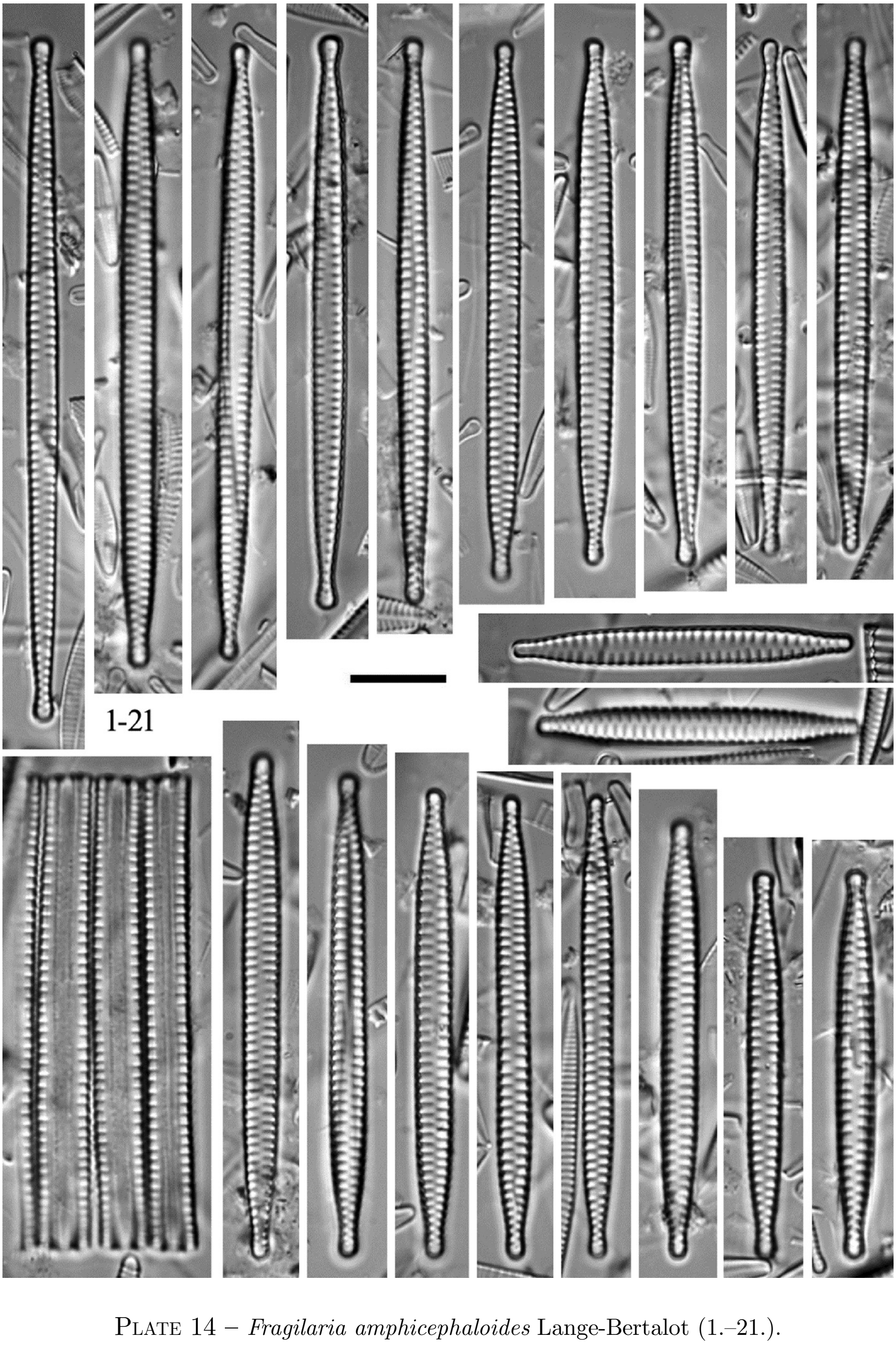

PLATE 14 – *Fragilaria amphicephaloides* Lange-Bertalot (1.–21.).

PLATE 15. *Fragilaria* sp. 2. nov.

Figs 1–23. *Fragilaria* sp. 2. nov.

Frustules are narrow, rectangular in girdle view. Valves strictly lanceolate with margins tapering to distinctly capitate apices. Mid-valve is distinctly convex. Valve length varies from 45–60 μm, and valve width is 3.0–4.0 μm. Axial area is narrow, lanceolate widening towards valve centre. Central area absent. Apical pore fields are present on both poles composed of small poroids. A single rimoportula is located near the valve apex. Striae are distinct, but areolae are hardly visible under LM. Striae parallel throughout the valve and extend midway onto the valve mantle, 13–18 in 10 μm. Costae are wider than the striae. Girdle bands are simple and open.

Fragilaria sp. 2 was so far observed in a few samples from Jiuzhaigou National nature reserve, and in sample 66 is quite frequent. Based on available literature, this taxon is different than previously known taxa and probably represents a new species.

Scale bar = 10 μm
LM 1500x

Figs 1–23. Jiuzhaigou National nature reserve, sample Acc. No. 66.

PLATE 16. *Fragilaria* sp. 3. nov.

Figs 1–36. *Fragilaria* sp. 3. Nov.

Frustules are narrow, rectangular in girdle view. Valves are linear to slightly linear-lanceolate. Valve margins parallel or weakly tapering to distinctly capitate apices. Mid-valve parallel. Valve length varies from 16–52 μm, and valve width is 2.5–3.0 μm. The axial area is narrow, lanceolate widening towards valve centre. Central area variable, absent due to the presence of “ghost” striae or bilateral fascia. Apical pore fields are present on both poles composed of small poroids. A single rimoportula is located near the valve apex. Striae are distinct, but areolae are hardly visible under LM. Striae parallel throughout the valve and extend midway onto the valve mantle, 14–16 in 10 μm. Costae are wider than the striae. Girdle bands are simple and open.

Fragilaria sp. 3 was so far observed in a few samples from Jiuzhaigou National nature reserve, and in sample 42 is quite frequent. Based on the available literature, this taxon is different than previously known taxa and probably represents a new species.

Scale bar = 10 μm
LM 1500x

Figs 1–36. Jiuzhaigou National nature reserve, sample Acc. No. 42.

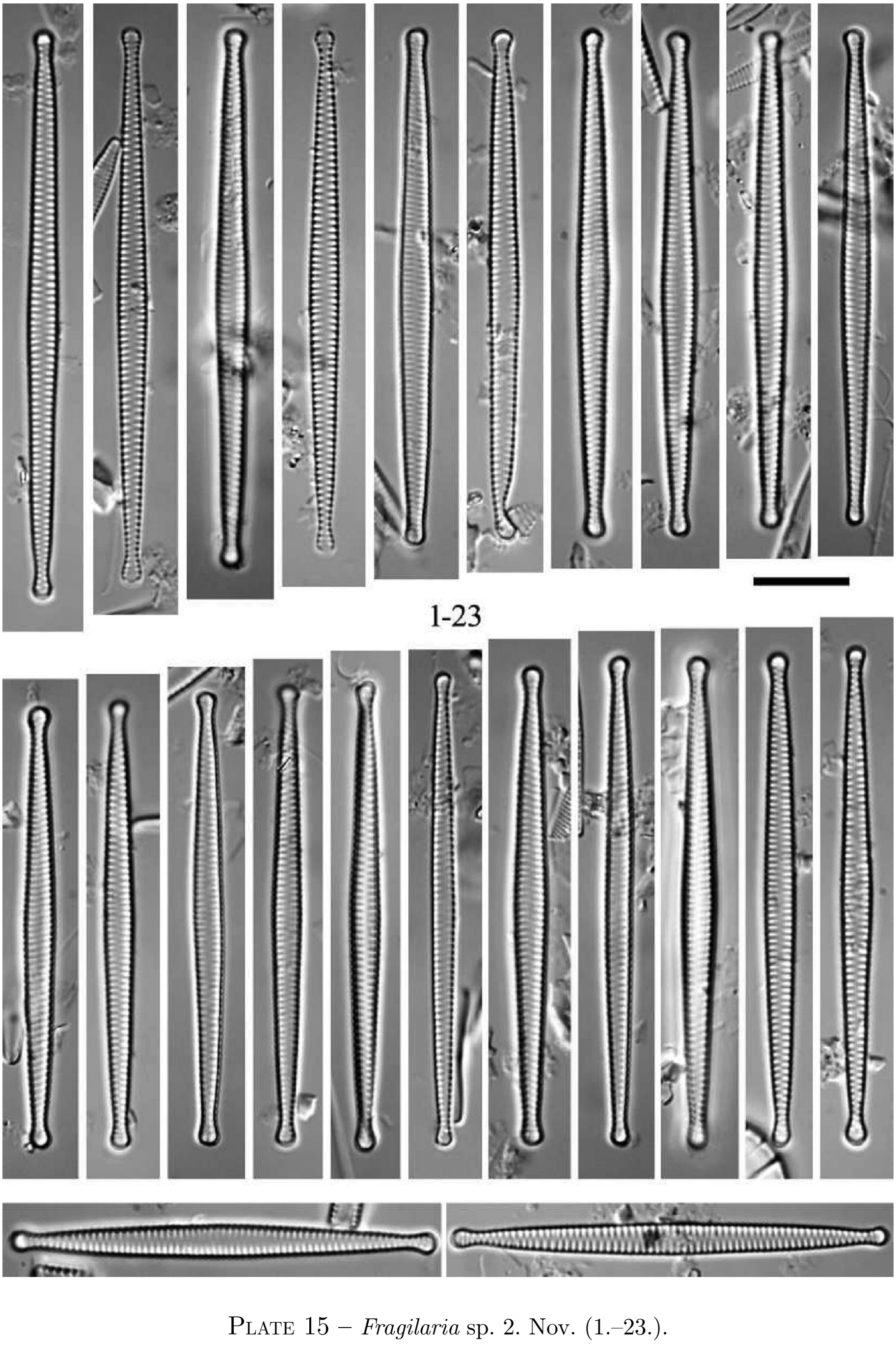

Plate 15 – *Fragilaria* sp. 2. Nov. (1.–23.).

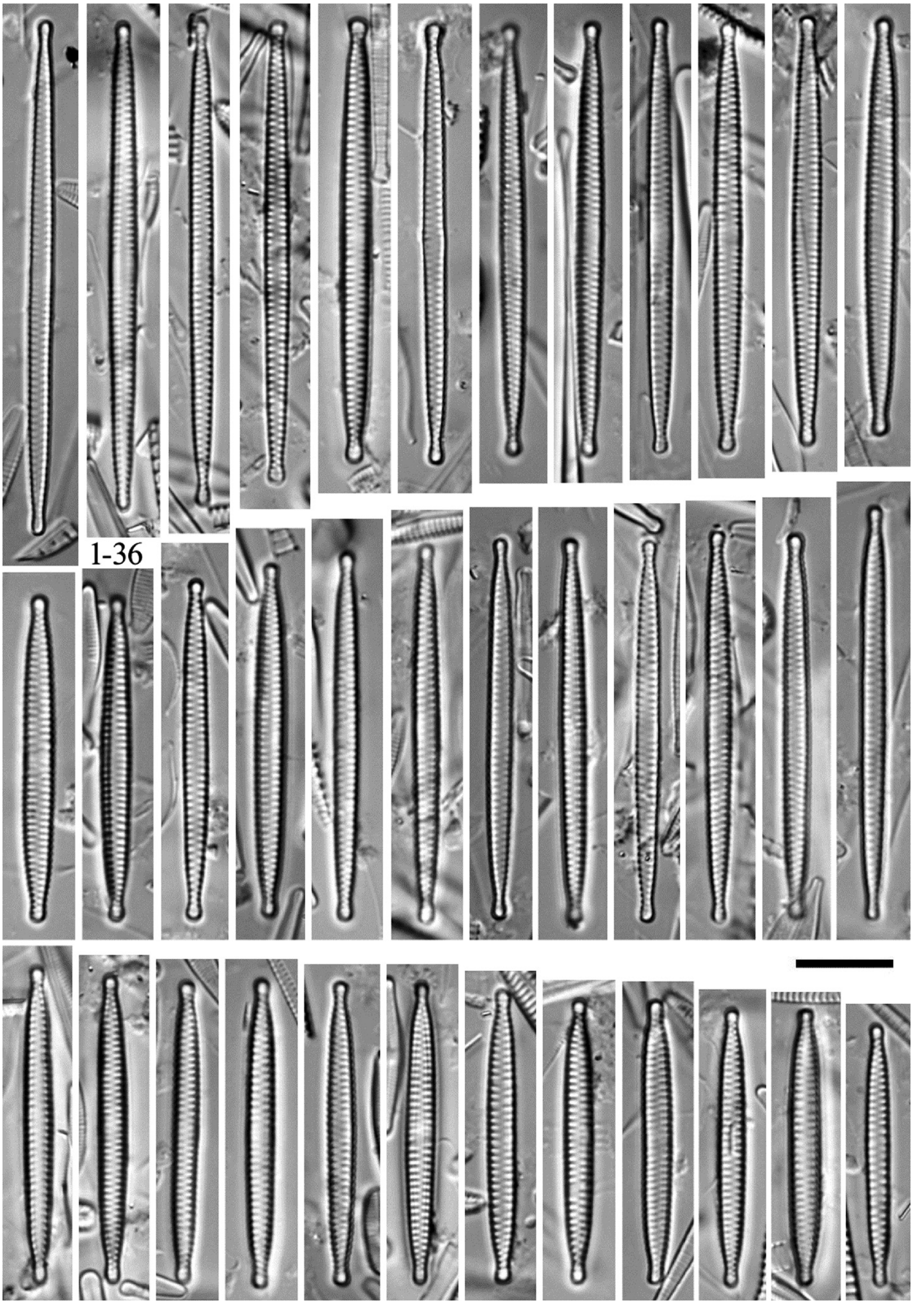

PLATE 16 – *Fragilaria* sp. 3. nov. (1.–36.).

PLATE 17. *Fragilaria* sp. 4. nov.

Figs 1–31. *Fragilaria* sp. 4. nov.

Frustules are narrow, rectangular in girdle view. Valves are linear-lanceolate to lanceolate. Valve margins tapering to distinctly capitate apices. Mid-valve convex. Valve length varies from 27–41 μm, valve width is 3.5–4.5 μm. Axial area is narrow, lanceolate widening towards the valve centre. Central area unilateral fascia. "Ghost" might be present in the central area. Apical pore fields are present on both poles composed of small poroids. A single rimoportula is located near the valve apex. Striae are distinct, but areolae are hardly visible under LM. Striae parallel throughout the valve and extend midway onto the valve mantle, 16–19 in 10 μm.

Fragilaria sp. 4 was so far observed in a few samples from Jiuzhaigou National nature reserve, and in sample 42 is quite frequent. Based on available literature, this taxon is different than previously known taxa and probably represents a new species.

Scale bar = 10 μm
LM 1500x

Figs 1–31. Jiuzhaigou National nature reserve, sample Acc. No. 42.

PLATE 18. *Fragilaria* sp. 5. nov.

Figs 1–43. *Fragilaria* sp. 5. nov.

Frustules are narrow, rectangular in girdle view. Valves are lanceolate to rhombic-lanceolate. Valve margins gradually tapered to weakly protracted and rostrate apices. Mid-valve convex and in smaller specimens strongly convex. Valve length varies from 15–30 μm, valve width is 4.0–4.5 μm. Axial area is narrow, lanceolate widening towards the valve centre. Central area small, unilateral fascia. "Ghost" are present in the central area. Apical pore fields are present on both poles composed of small poroids. A single rimoportula is located near the valve apex. Striae are distinct, but areolae are hardly visible under LM. Striae parallel in the mid-valve, becoming radiate towards apices and extend midway onto the valve mantle, 16–20 in 10 μm.

Fragilaria sp. 5 was so far observed in a few samples from Jiuzhaigou National nature reserve, and in sample 71 – 5H is quite frequent. This taxon is quite similar to previous (*Fragilaria* sp. 4) and might represent a morphological variation of it. Additional observations, especially on SEM are necessary for establishing their proper identity and possible conspecificity.

Scale bar = 10 μm
LM 1500x

Figs 1–43. Jiuzhaigou National nature reserve, sample Acc. No. 71 – 5H.

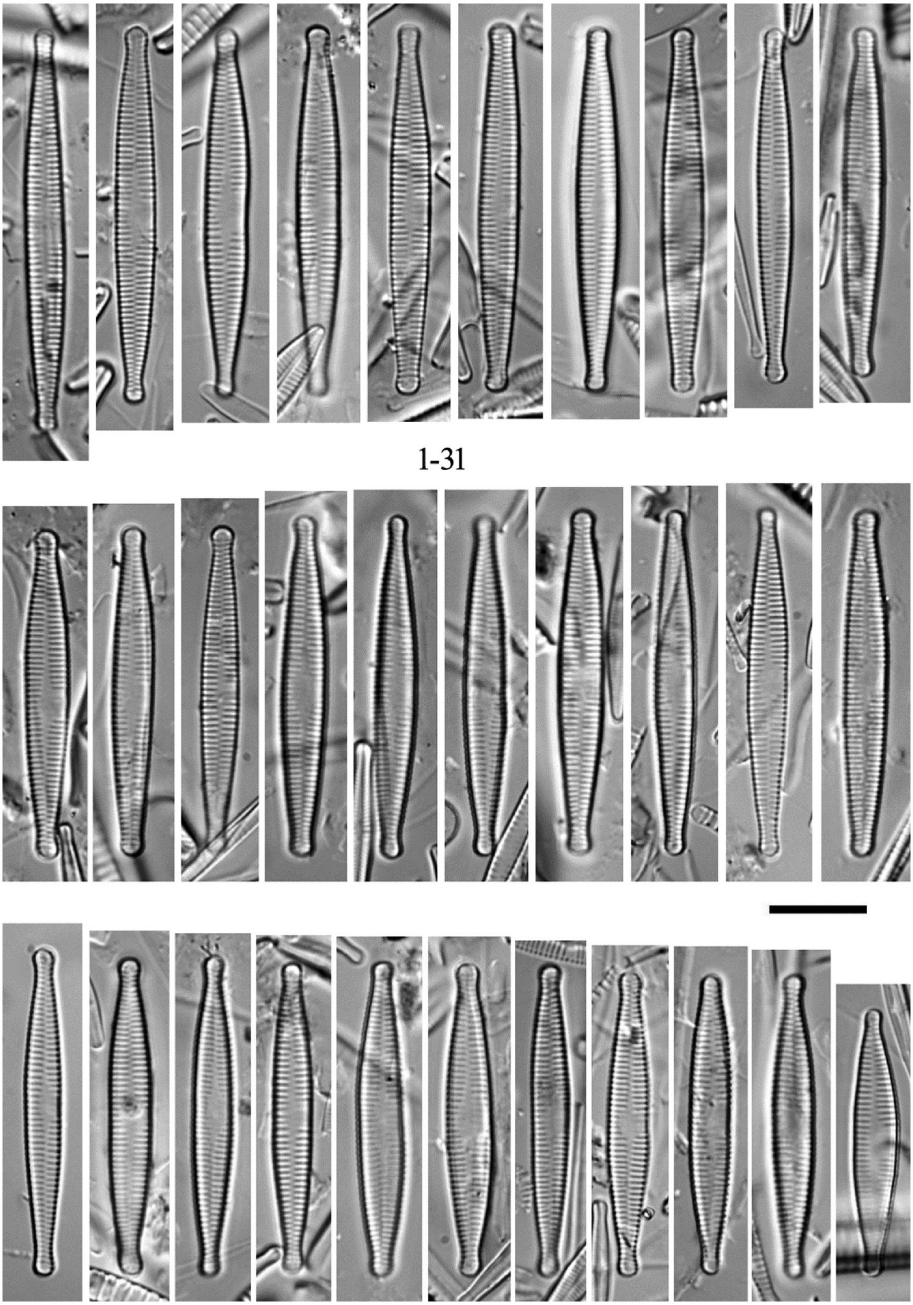

Plate 17 – *Fragilaria* sp. 4. nov. (1.–31.).

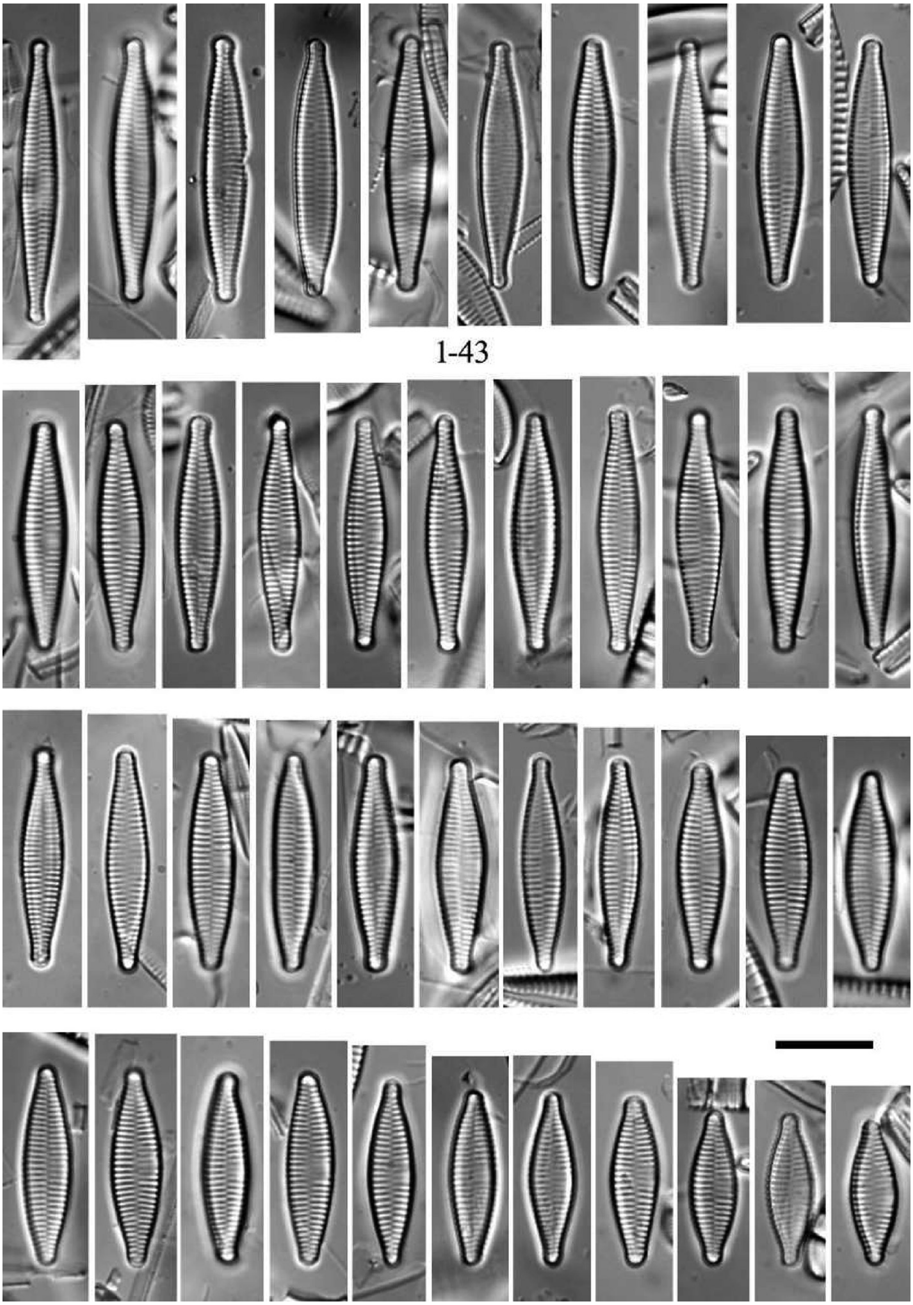

Plate 18 – *Fragilaria* sp. 5. nov. (1.–43.).

PLATE 19. *Fragilaria* sp. 6. nov.

Figs 1–47. *Fragilaria* sp. 6. nov.

Frustules are narrow, rectangular in girdle view. Valves are linear to linear-lanceolate. Valve margins parallel to weakly convex, gradually tapering to subcapitate to capitate apices. Mid-valve is parallel to weakly convex. Valve length varies from 18–27 μm, valve width is 3.0–3.5 μm. Axial area is narrow, linear, and slightly widened near the valve centre. Central area small, variable in shape, round to unilateral fascia. "Ghost" is present in the central area. Apical pore fields are present on both poles composed of small poroids. A single rimoportula is located near the valve apex. Striae are distinct, but areolae are hardly visible under LM. Striae parallel in the mid-valve, becoming radiate towards apices and extend midway onto the valve mantle, 16–20 in 10 μm.

Fragilaria sp. 6 was so far observed in a few samples from Jiuzhaigou National nature reserve, and in sample 66 is quite frequent. Based on the available literature, this taxon is different than previously known taxa and probably represents a new species.

Scale bar = 10 μm
LM 1500x

Figs 1–47. Jiuzhaigou National nature reserve, sample Acc. No. 66.

PLATE 20. *Fragilaria delicatissima* (W. Smith) Lange-Bertalot, *Fragilaria* sp. aff *radians* (Kützing) D.M. Williams & F.E. Round, *Fragilaria mesolepta* Rabenhorst

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Figs 1–9. *Fragilaria delicatissima* (W. Smith) Lange-Bertalot

Frustules are narrow, rectangular in girdle view. Valves are very narrow, lanceolate with margins tapering to slightly rostrate to subcapitate apices. Mid- valve slightly convex. Valve length varies from 66–95 μm, valve width is 2.5–3.0 μm. Axial area is narrow, lanceolate, tapering towards central area. Central area variable, is indistinct, due to the presence of "ghost" striae to broad fascia. Apical pore fields are present on both poles composed of small poroids. A single rimoportula is located near the valve apex. Striae are fine, and areolae are not visible under LM. Striae parallel throughout the valve, alternating, 13–15 in 10 μm, and extend midway onto the valve mantle. Costae are wider than the striae. Girdle bands are simple and open.

Fragilaria delicatissima is considered a widely spread (cosmopolitan) species, however, in the study it was rarely observed.

Figs 10–17. *Fragilaria* sp. aff *radians* (Kützing) D.M. Williams & F.E. Round

Frustules are narrow, rectangular in girdle view. Valves are linear to linear-lanceolate. Valve margins parallel to weakly convex, gradually tapering to narrowly protracted apices. Mid-valve is parallel. Valve length varies from 27–36 μm, valve width is 3.0–3.5 μm. Axial area is narrow, linear, and slightly widened near the valve centre. Central area is small, variable in shape, and almost absent of unilateral fascia. "Ghost" is present in the central area. Some specimens might have swollen central parts. Apical pore fields are present on both poles composed of small poroids. A single rimoportula is located near the valve apex. Striae are distinct, but areolae are hardly visible under LM. Striae parallel in the mid-valve, becoming radiate towards apices and extend midway onto the valve mantle, 10–12 in 10 μm.

Fragilaria sp. aff *radians* appear similar to *F. radians*, but latter has slightly coarser striae and a distinct central area. In the study area (Jiuzhaigou National nature reserve) it is rare and additional observations are necessary for establishing its proper taxonomic status.

Fig. 18. *Fragilaria mesolepta* Rabenhorst

According to morphological characteristics, this specimen fits the description of *F. mesolepta*.

Scale bar = 10 μm
LM 1500x

Figs 1–9. Jiuzhaigou National nature reserve, sample Acc. No. JG P1 V1.
Figs 10–18. Jiuzhaigou National nature reserve, sample Acc. No. 40.

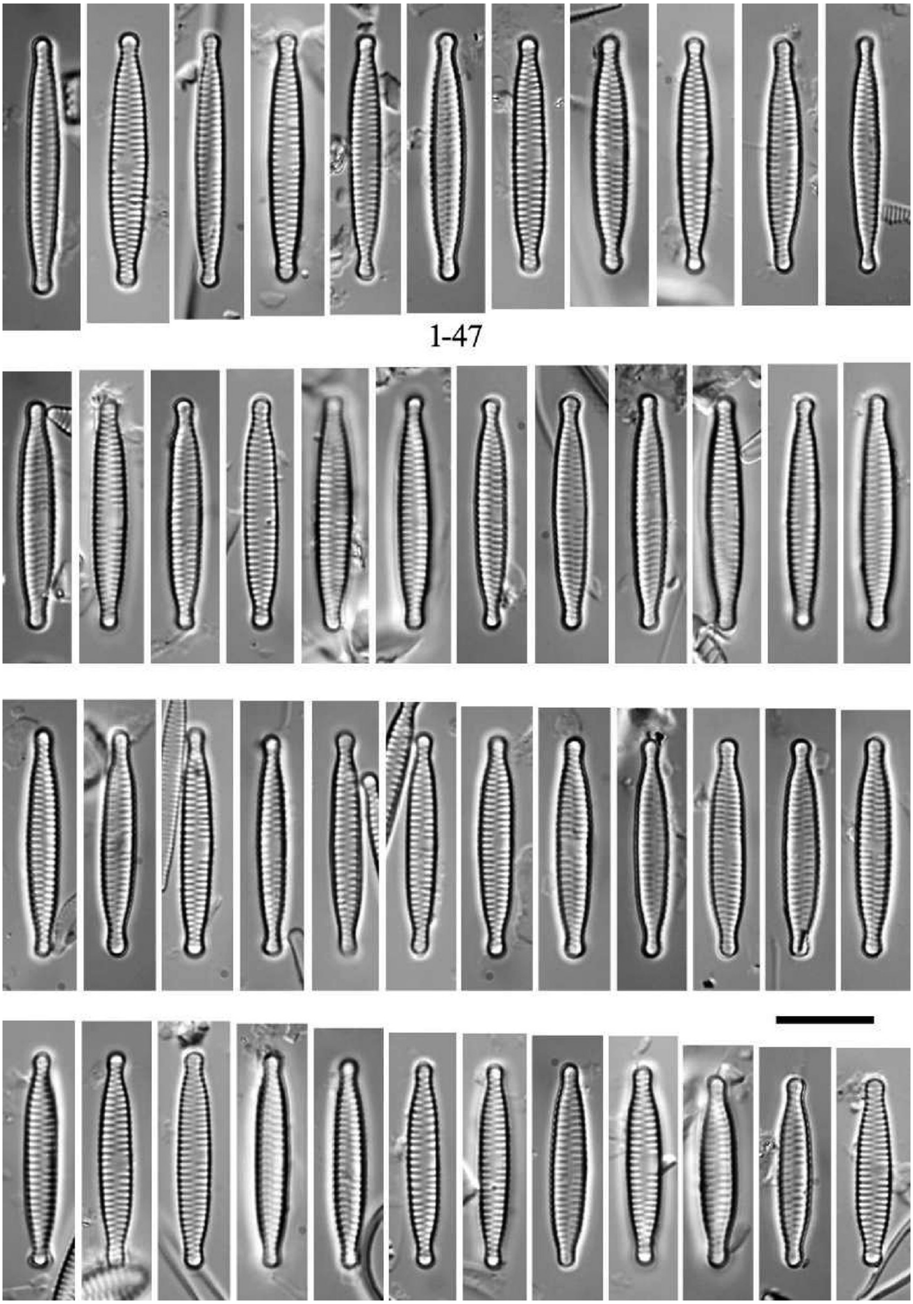

PLATE 19 – *Fragilaria* sp. 6. nov. (1.–47.).

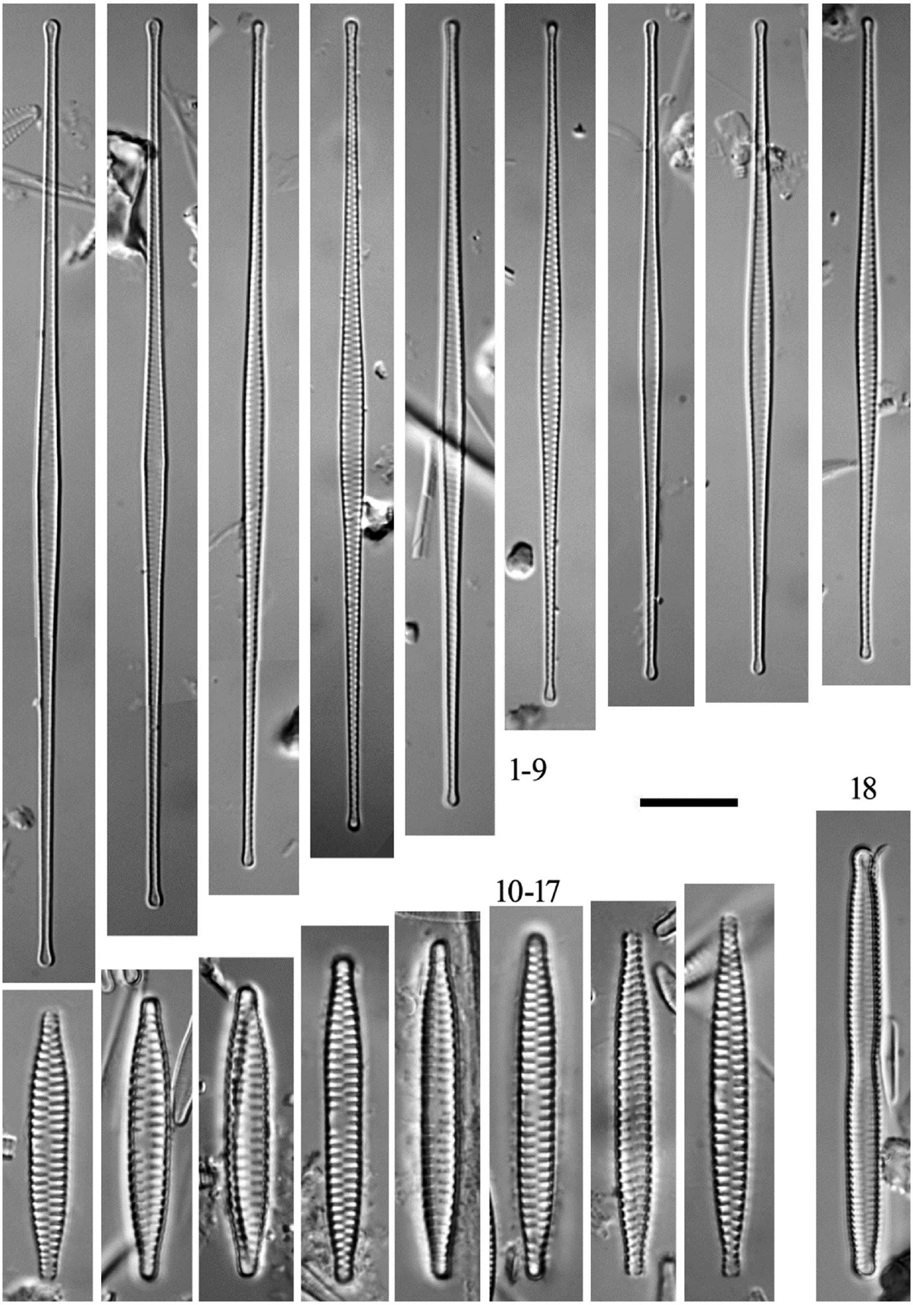

Plate 20 – *Fragilaria delicatissima* (W. Smith) Lange-Bertalot (1.–9.), *Fragilaria* sp. aff *radians* (Kützing) D.M. Williams & F.E. Round (10.–17.), *Fragilaria mesolepta* Rabenhorst (18.).

PLATE 21. *Fragilaria gracilis* Østrup, *Fragilaria recapitellata* Lange-Bertalot & Metzeltin, *Fragilaria vaucheriae* (Kützing) J.B. Petersen, *Staurosira vente*r (Ehrenberg) Cleve & J.D. Möller

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Figs 1–20. *Fragilaria gracilis* Østrup

Frustules are narrow, rectangular in girdle view. Valves are linear to linear-lanceolate. Valve margins parallel to weakly convex, gradually tapering to narrowly subprotracted apices. Mid-valve is parallel to weakly convex. Valve length varies from 16–34 μm, valve width is 2.0–3.0 μm. Axial area is narrow, lanceolate, gradually widening towards the valve centre. Central area variable in shape, almost absent due to the presence of "ghost" striae, to the small bilateral fascia. Apical pore fields are present on both poles composed of small poroids. A single rimoportula is located near the valve apex. Striae are fine, and areolae are not visible under LM. Striae parallel in the mid-valve, becoming slightly radiate towards apices and extend midway onto the valve mantle, 20–24 in 10 μm. *Fragilaria gracilis* is considered a widely spread (cosmopolitan) species, but in the study area was observed in sample Acc. No. 41.

Figs 21–24. *Fragilaria recapitellata* Lange-Bertalot & Metzeltin

Valves are lanceolate to rhombic-lanceolate in smaller specimens. Valve margins convex, gradually tapering to protracted and subcapitate apices. Mid-valve is convex and unilaterally swollen. Valve length varies from 11–24 μm, valve width is 4.5–5.0 μm. Axial area is narrow, lanceolate, gradually widening towards the valve centre. Central area variable in shape, usually unilateral fascia. Striae are coarse, and areolae are not visible under LM. Striae parallel in the mid-valve, becoming slightly radiate towards apices and extend midway onto the valve mantle, 12–16 in 10 μm.

Figs 25–29. *Fragilaria vaucheriae* (Kützing) J.B. Petersen

Valves are linear to linear-lanceolate in smaller specimens. Valve margins parallel or convex, gradually tapering to protracted apices. Mid-valve is convex and unilaterally swollen. Valve length varies from 11–24 μm, valve width is 4.5–5.0 μm. Axial area is narrow, linear. Central area unilateral fascia. Striae are coarse, and areolae are not visible under LM, parallel in the mid-valve, becoming slightly radiate towards apices, 12–14 in 10 μm

Figs 30–43. *Staurosira venter* (Ehrenberg) Cleve & J.D. Möller

Scale bar = 10 μm
LM 1500x

Figs 1–20. Jiuzhaigou National nature reserve, sample Acc. No. 41.
Figs 21–43. Jiuzhaigou National nature reserve, sample Acc. No. 40.

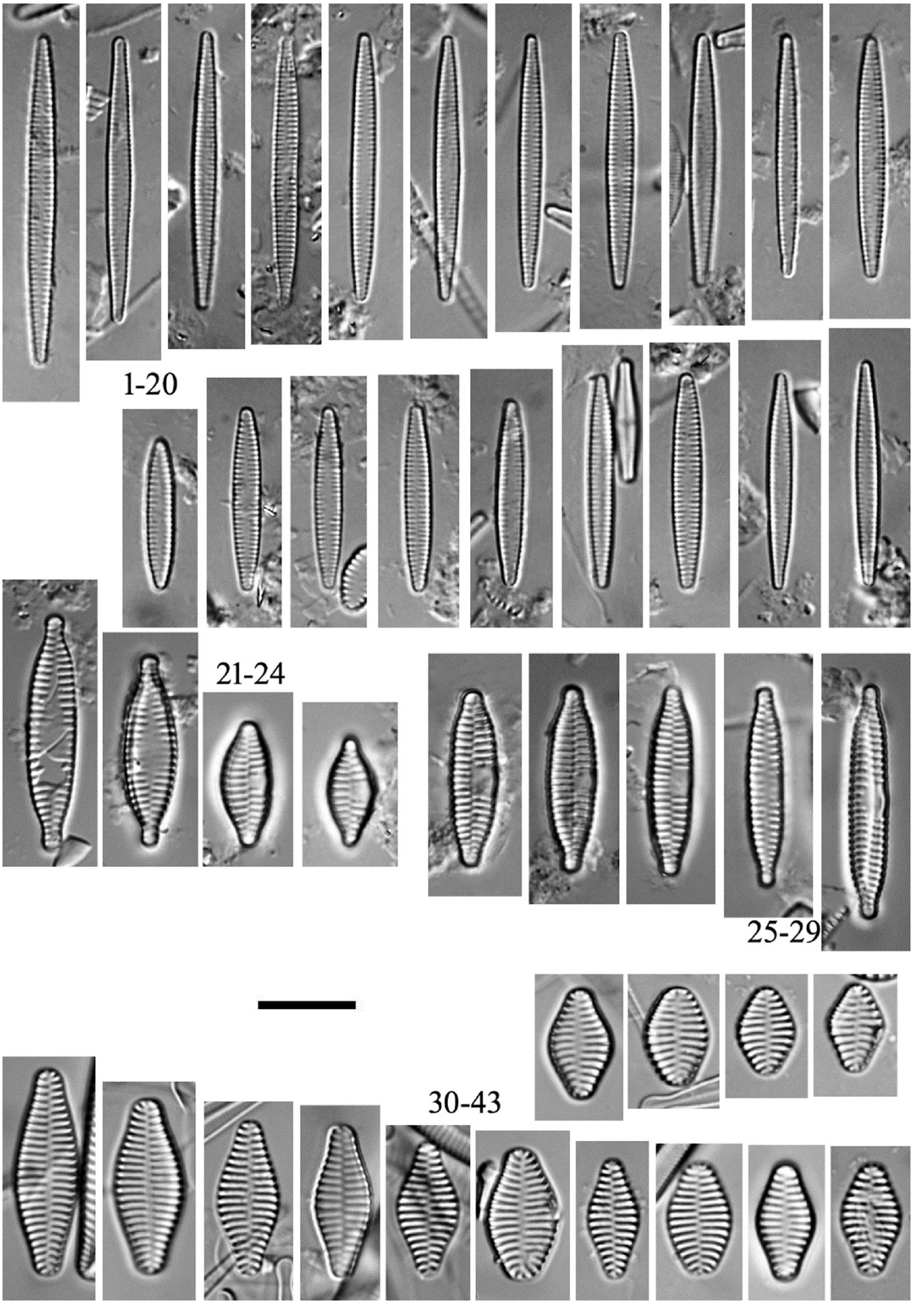

Plate 21 – *Fragilaria gracilis* Østrup (1.–20.), *Fragilaria recapitellata* Lange-Bertalot & Metzeltin (21.–24.), *Fragilaria vaucheriae* (Kützing) J.B. Petersen (25.–29.), *Staurosira venter* (Ehrenberg) Cleve & J.D. Möller (30.–43.).

PLATE 22. *Fragilaria* sp. 7, *Fragilaria* sp. aff. *vaucheriae* (Kützing) Petersen, *Fragilaria* sp. aff. *henryi* Lange-Bertalot

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Figs 1–27. *Fragilaria* sp. 7

Valves are linear-lanceolate to lanceolate. Valve margins convex, gradually tapering to protracted and subcapitate apices. Mid-valve is convex. Valve length varies from 14–26 μm, valve width is 3.0–3.5 μm. Axial area is wide, lanceolate, gradually widening towards the valve centre. Central area variable in shape, absent of unilateral fascia. Striae are coarse, and areolae are not visible under LM. Striae parallel in the mid-valve, becoming slightly radiate towards apices and extend midway onto the valve mantle, 12–14 in 10 μm.

Fragilaria sp. 7 was so far observed in a few samples from Jiuzhaigou National nature reserve, and in sample 66 is frequent. Based on the available literature, this taxon is different than previously known taxa and probably represents a new species.

Figs 28–31. *Fragilaria* sp. aff. *vaucheriae* (Kützing) Petersen

Figs 32–40. *Fragilaria* sp. aff. *henryi* Lange-Bertalot

Frustules are narrow, rectangular in girdle view. Valves are linear to linear-lanceolate. Valve margins parallel to weakly convex, gradually tapering to narrowly protracted apices. Mid-valve is parallel. Valve length varies from 20–26 μm, valve width is 2.5–3.0 μm. Axial area is narrow, linear, and slightly widened near the valve centre. Central area is small, variable in shape, and almost absent of unilateral fascia. “Ghost” is present in the central area. Some specimens might have slightly swollen central parts. Apical pore fields are present on both poles composed of small poroids. A single rimoportula is located near the valve apex. Striae are distinct, but areolae are hardly visible under LM. Striae parallel in the mid-valve, becoming radiate towards apices and extend midway onto the valve mantle, 16–18 in 10 μm.

Fragilaria sp. aff. *henryi* appear similar to *F. henryi*, but the latter have coarser striae clearly visible areolae, and a distinct central area. In the study area (Jiuzhaigou National nature reserve) it is rare and additional observations are necessary for establishing its proper taxonomic status.

Scale bar = 10 μm
LM 1500x

Figs 1–17. Jiuzhaigou National nature reserve, sample Acc. No. 66.
Figs 18–40. Jiuzhaigou National nature reserve, sample Acc. No. 41.

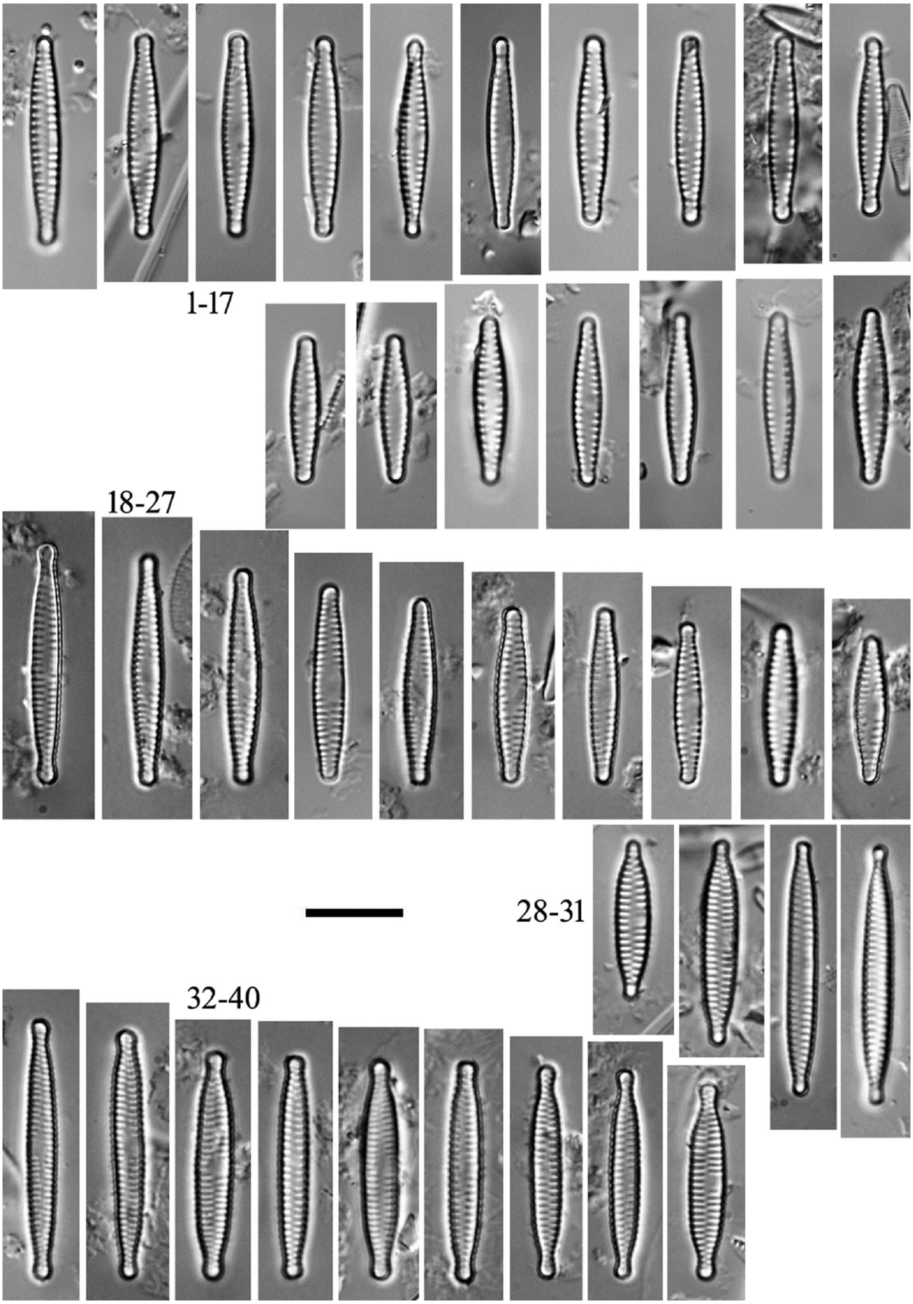

Plate 22 – *Fragilaria* sp. 7 (1.–27.), *Fragilaria* sp. aff. *vaucheriae* (Kützing) Petersen (28.–31.), *Fragilaria* sp. aff. *henryi* Lange-Bertalot (32.–40.).

PLATE 23. *Ulnaria ulna* var. *subaequalis* (Grunow) Aboal, *Ulnaria ulna* (Nitzsch) Compère

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Figs 1–4. *Ulnaria ulna* var. *subaequalis* (Grunow) Aboal

Valves are elongated and linear, with a straight valve margin in the middle and slightly tapers towards valve ends. Valve apices slightly rostrate to subcapitate. Valves length is 120–160 μm, valve width is 5.0–6.0 μm. Axial area is narrow linear, only slightly widened near the valve centre. Central area is absent or small rectangular surrounded by shortened, marginal striae. Striae are nearly parallel and arranged opposite one another, 10–11 in 10 μm, near the poles the striae become radiated and alternate with one another.

Ulnaria ulna var. *subaequalis* is considered a widely spread (cosmopolitan) species and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 5, 6. *Ulnaria ulna* (Nitzsch) Compère

Valves are elongated and linear, with a straight valve margin in the middle and taper towards valve ends. Valve apices rostrate to subcapitate. Valves length is 80–160 μm, valve width is 6.5–7.5 μm. Axial area is narrow linear, only slightly widened near the valve centre. Central area is large, rectangular fascia surrounded by shortened, marginal striae. "Ghost" striae are present in the central area. Striae are nearly parallel and arranged opposite one another, 10–11 in 10 μm, near the poles the striae become radiated and alternate with one another.

Ulnaria ulna is considered a widely spread (cosmopolitan) species and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1200x

Figs 1–4. Jiuzhaigou National nature reserve, sample Acc. No. D2.
Figs 5, 6. Jiuzhaigou National nature reserve, sample Acc. No. D1.

PLATE 24. *Ulnaria* sp. aff. *contracta* (Østrup) E. Morales & M.L. Vis, *Ulnaria acus* (Kützing) Aboal

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Figs 1–12. *Ulnaria* sp. aff. *contracta* (Østrup) E. Morales & M.L. Vis

Valves are linear, with a slightly constricted central margin. The valve margin tapering towards the valve ends. Valve apices are capitate to subcapitate. Valves length varies from 48–71 μm valve width in mid-valve 6.0–6.5 μm in width. Axial area is narrow linear, only slightly widened near the valve centre. Central area is large, rectangular fascia. The central area may be surrounded by shortened, marginal striae. "Ghost" striae are present in the central area. Striae are nearly parallel and arranged opposite one another, 12–14 in 10 μm, near the poles the striae become radiate and alternate with one another.

Ulnaria sp. aff. *contracta* appear similar to *U. contracta,* but is smaller and has lower central constriction. This taxon was rare in the study area, and most frequently observed in the sample Acc. No. D1.

Fig. 13. *Ulnaria acus* (Kützing) Aboal

Valves are narrow and lanceolate. The valve margin is tapering towards narrowly rounded to sub-rostrate or sub-capitate apices. Valve length 60–200 μm. The axial area is narrow lanceolate and slightly expanded near the central area. Central area is a large fascia that may be surrounded by shortened, marginal striae. "Ghost" striae are also present in the central area. A single rimoportula is present at the valve end. The striae are coarse, 11–12 in 10 μm, occurring opposite in the middle of the valve and becoming alternate towards apices.

Ulnaria acus is considered a widely spread (cosmopolitan) species, but in the study area, only a few specimens have been observed. Recently six new species of Ulnaria (Bacillariophyta) have been described from the Wuling Mountains Area, P.R. China (Liu *et al.*, 2017a, 2019a).

Scale bar = 10 μm
LM 1500x

Figs 1–13. Jiuzhaigou National nature reserve, sample Acc. No. D1.

PLATE 25. *Hannaea arcus* (Ehrenberg) R.M. Patrick

Figs 1–22. *Hannaea arcus* (Ehrenberg) R.M. Patrick

Valves are asymmetric to the apical axis, lunate, the dorsal margin is highly arched and convex, while the ventral margin is concave and slightly swollen in the mid-valve. Valve apices distinctly set off, capitate. Valve length varies from 25–80 μm, valve width is 5.0–6.0 μm. Axial area is narrow, following the valve curvature. Central area unilateral fascia. Ghost striae may be present in the central area. Striae uniseriate, parallel in the middle, becoming radiate towards the apices, 13–14 in 10 μm. A single rimoportula is present, located near the valve apex. Apical pore fields are present on both valve apices, located on valve mantle.

Hannaea arcus is considered a widely spread (cosmopolitan) species and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–22. Jiuzhaigou National nature reserve, sample Acc. No. 41.

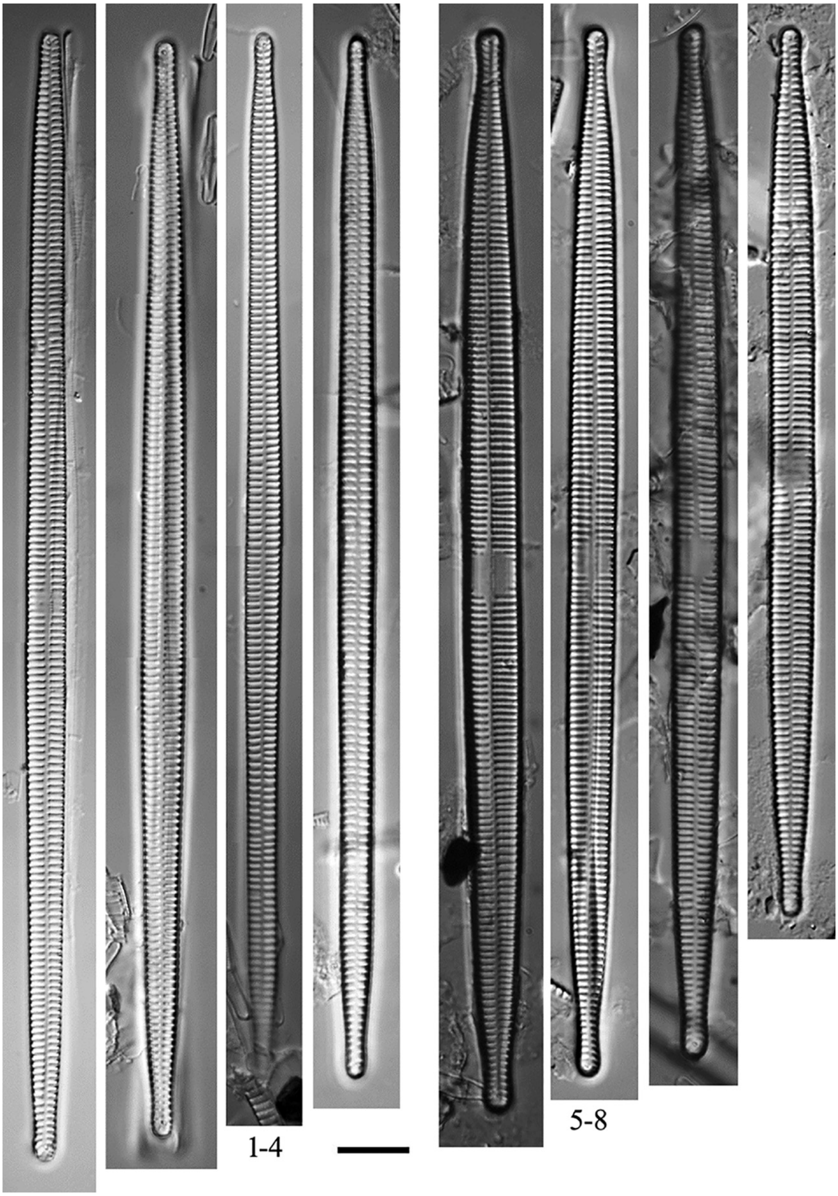

Plate 23 – *Ulnaria ulna* var. *subaequalis* (Grunow) Aboal (1.–4.), *Ulnaria ulna* (Nitzsch) Compère (5. i 6.).

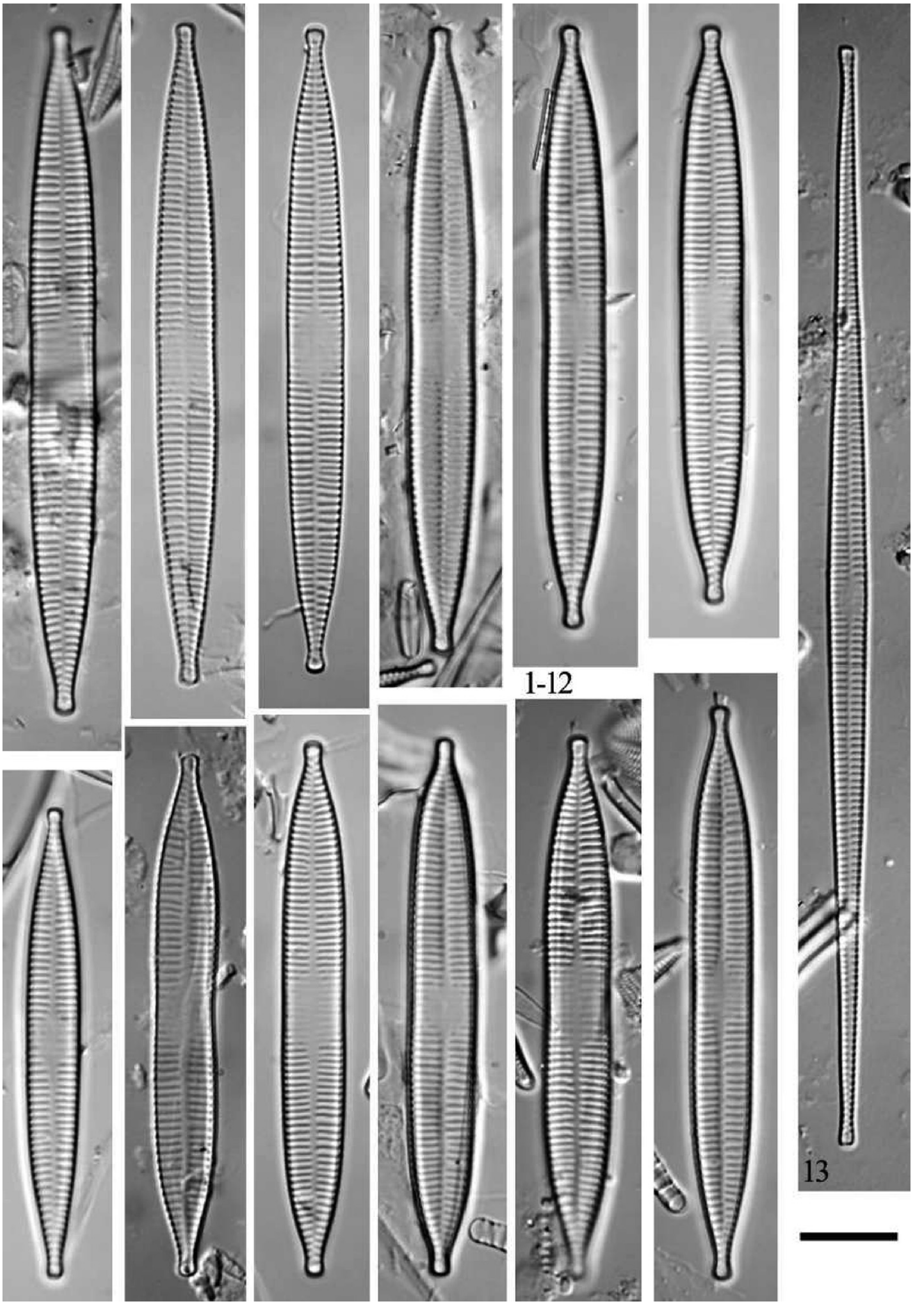

Plate 24 – *Ulnaria* sp. aff. *contracta* (Østrup) E. Morales & M.L. Vis (1.–12.), *Ulnaria acus* (Kützing) Aboal (13.).

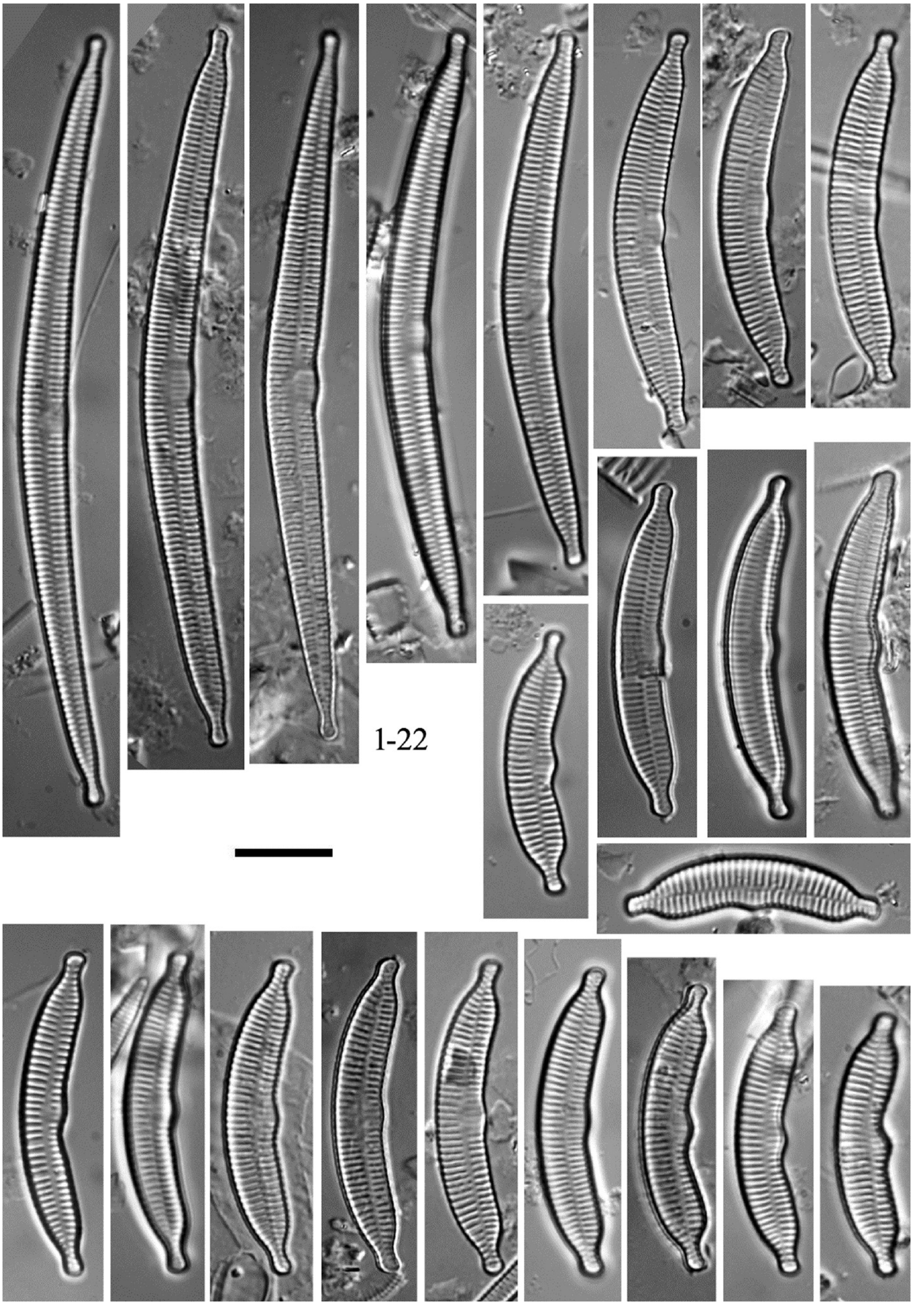

Plate 25 – *Hannaea arcus* (Ehrenberg) R.M. Patrick (1.–22.).

PLATE 26. *Hannaea orientalis* (Skuja) Q. Liu, Glushchenko, Kulikovskiy & Kociolek

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Figs 1–20. *Hannaea orientalis* (Skuja) Q. Liu, Glushchenko, Kulikovskiy & Kociolek

Valves are slightly asymmetric to the apical axis, lunate, the dorsal margin is slightly arched and convex, while the ventral margin is slightly concave and swollen in the mid-valve. Valve apices distinctly set off, broadly capitate. Valve length varies from 35–63 μm, valve width is 3.5–5.0 μm. Axial area narrow, following the valve curvature. Central area small, unilateral fascia. Ghost striae may be present in the central area. Striae uniseriate, parallel in the middle, becoming radiate towards the apices, 13–16 in 10 μm. A single rimoportula is present, located near the valve apex. Apical pore fields are present on both valve apices, located on valve mantle.

Hannaea orientalis is rarely reported species. It was described by Skuja (1937) from Yunnan as *Ceratoneis arcus* var. *orientalis* Skuja. Recently, Liu *et al.* (2019b) transferred to the genus Hannaea without illustration of any specimen. Probably this species is endemic to P.R. China.

Scale bar = 10 μm
LM 1500x

Figs 1–20. Jiuzhaigou National nature reserve, sample Acc. No. 42.

PLATE 27. *Staurosira venter* (Ehrenberg) Cleve & J.D. Möller *sensu lato*, *Staurosira venter* (Ehrenberg) Cleve & J.D. Möller, *Staurosirella* sp., *Punctastriata* sp. aff. *mimetica* E. Morales

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Figs 1–61. *Staurosira venter* (Ehrenberg) Cleve & J.D. Möller *sensu lato*

Frustules in girdle view are rectangular and form ribbon-like colonies joined by linking spines. Valves are lanceolate to linear-lanceolate in larger specimens to elliptical in smaller specimens. Valve apices are broadly rounded. Valves are 8–15 μm long and 4.0–5.0 μm wide. The axial area is narrow to widely lanceolate. The striae are distinct, alternate, and composed of oval areolae. Striae are parallel in the middle, becoming radiate towards ends 12–16 in 10 μm.

Staurosira venter is considered a widely spread (cosmopolitan) species and it was frequently observed in the samples from Jiuzhaigou National nature reserve. This species is considered very variable in shape and size even in a single population. Additional observations are necessary to resolve the taxonomic status of many populations reported as *S. venter.*

Figs 62–65. *Staurosira venter* (Ehrenberg) Cleve & J.D. Möller

This is another example of Staurosira that belongs to S. venter complex. This population is more similar to the European population as depicted in Lange-Bertalot *et al.* (2017). See also figs 21: 30–43.

Figs 66, 67. *Staurosirella* sp.

Figs 68, 69. *Punctastriata* sp. aff. *mimetica* E. Morales

Valves are slightly asymmetrical, clavate, broadly with broadly rounded headpole and narrowly rounded to subcapitate footpole. Valves 14–15 μm long and 4.0–4.5 μm wide. The valve face is undulated due to raised costae. The axial area is narrow, lanceolate, central area is absent. Striae are distinct, and composed of up to four rows of round areolae. Striae parallel in the middle, becoming radiate towards poles, 9–11 in 10 μm.

This taxon appears similar to *Punctastriata mimetica*, but it differs in the valve shape and valve width. However, it is very rare in the study area and additional observations are necessary for establishing its proper identity.

Scale bar = 10 μm
LM 1500x

Figs 1–69. Jiuzhaigou National nature reserve, sample Acc. No. 41.

PLATE 28. *Staurosirella leptostauron* (Ehrenberg) D.M. Williams & F.E. Round

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Figs 1–30. *Staurosirella leptostauron* (Ehrenberg) D.M. Williams & F.E. Round

Cells form ribbon-like colonies, joined by linking spines. Valves are cruciform, with a strongly inflated central parts and narrowly rounded poles. Valve length varies from 13–23 μm, and valve width is 9.5–15.0 μm. Axial area narrow, lanceolate, central area variable in size, narrow to wide. Striae are distinct, and composed of slit-like areolae (lineolae), extending onto the valve mantle. Striae parallel in the middle, becoming radiate towards valve apices. 6–10 in 10 μm. Costae are narrower than the striae. Girdle bands are closed and without areolae or pores.

Staurosirella leptostauron is considered a widely spread (cosmopolitan) species and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–30. Jiuzhaigou National nature reserve, sample Acc. No. 72 – 2H.

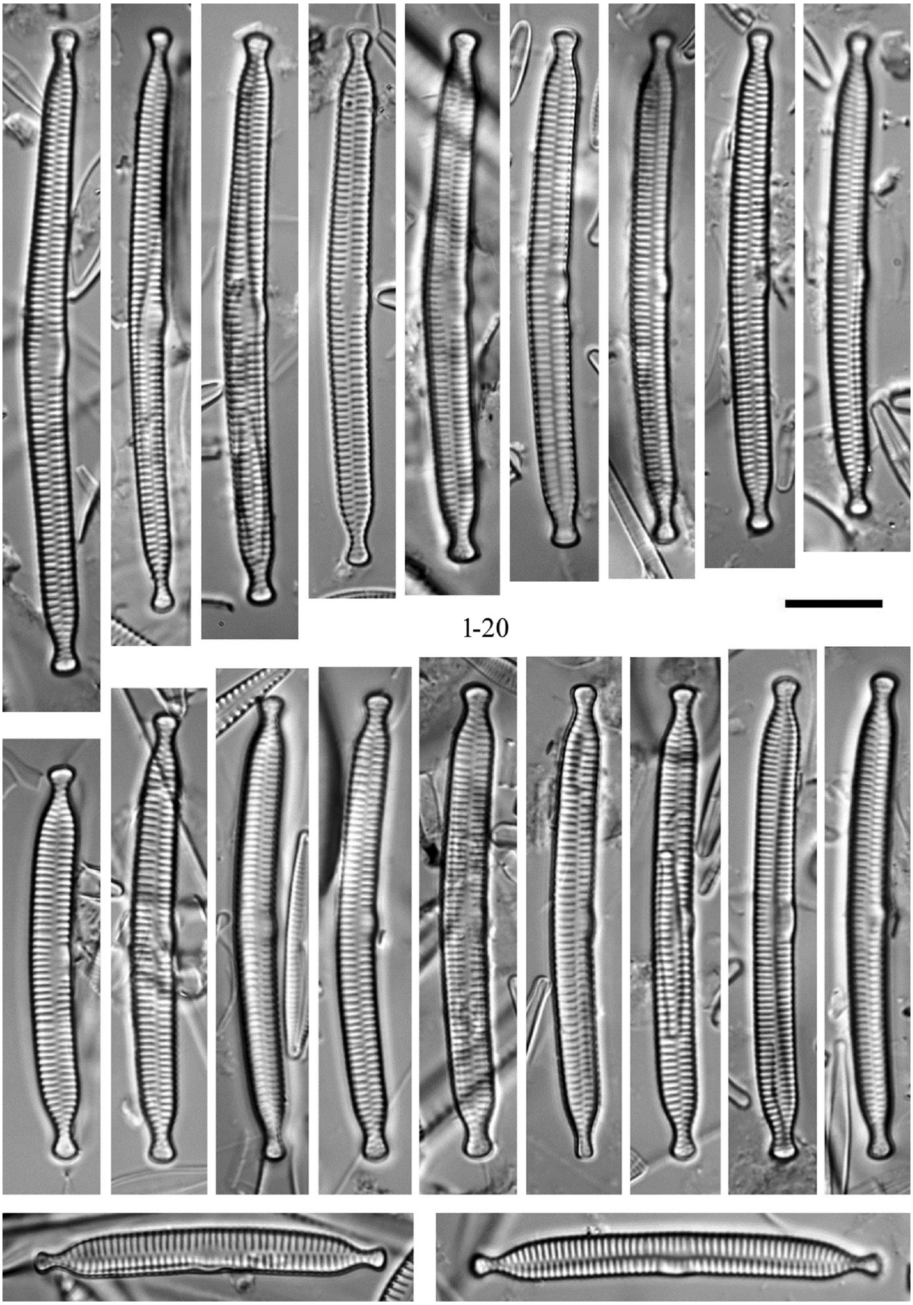

Plate 26 – *Hannaea orientalis* (Skuja) Q. Liu, Glushchenko, Kulikovskiy & Kociolek (1.–20.).

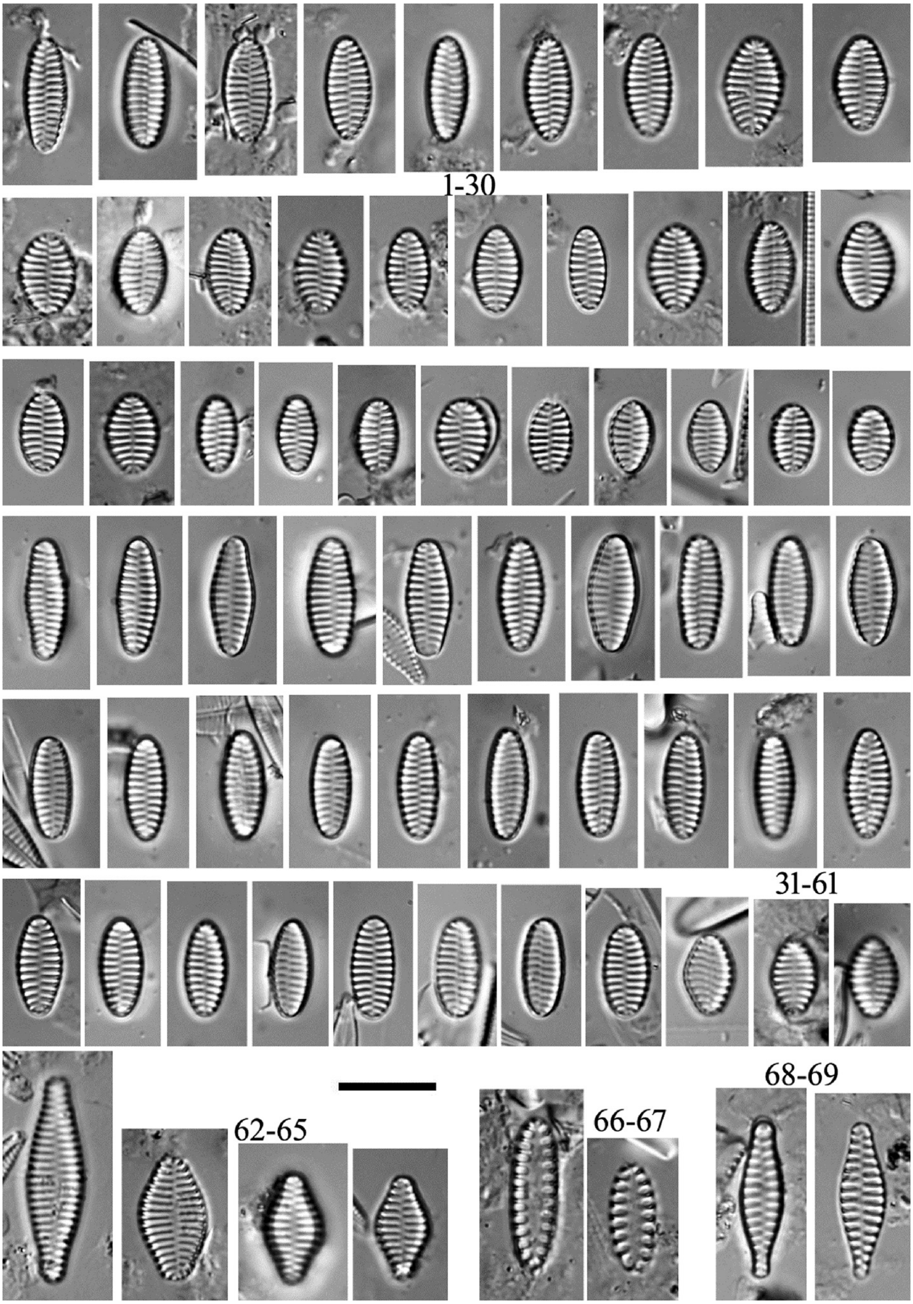

Plate 27 – *Staurosira venter* (Ehrenberg) Cleve & J.D. Möller *sensu lato* (1.–61.), *Staurosira venter* (Ehrenberg) Cleve & J.D. Möller (62.–65.), *Staurosirella* sp. (66., 67.), *Punctastriata* sp. aff. *mimetica* E. Morales (68., 69.).

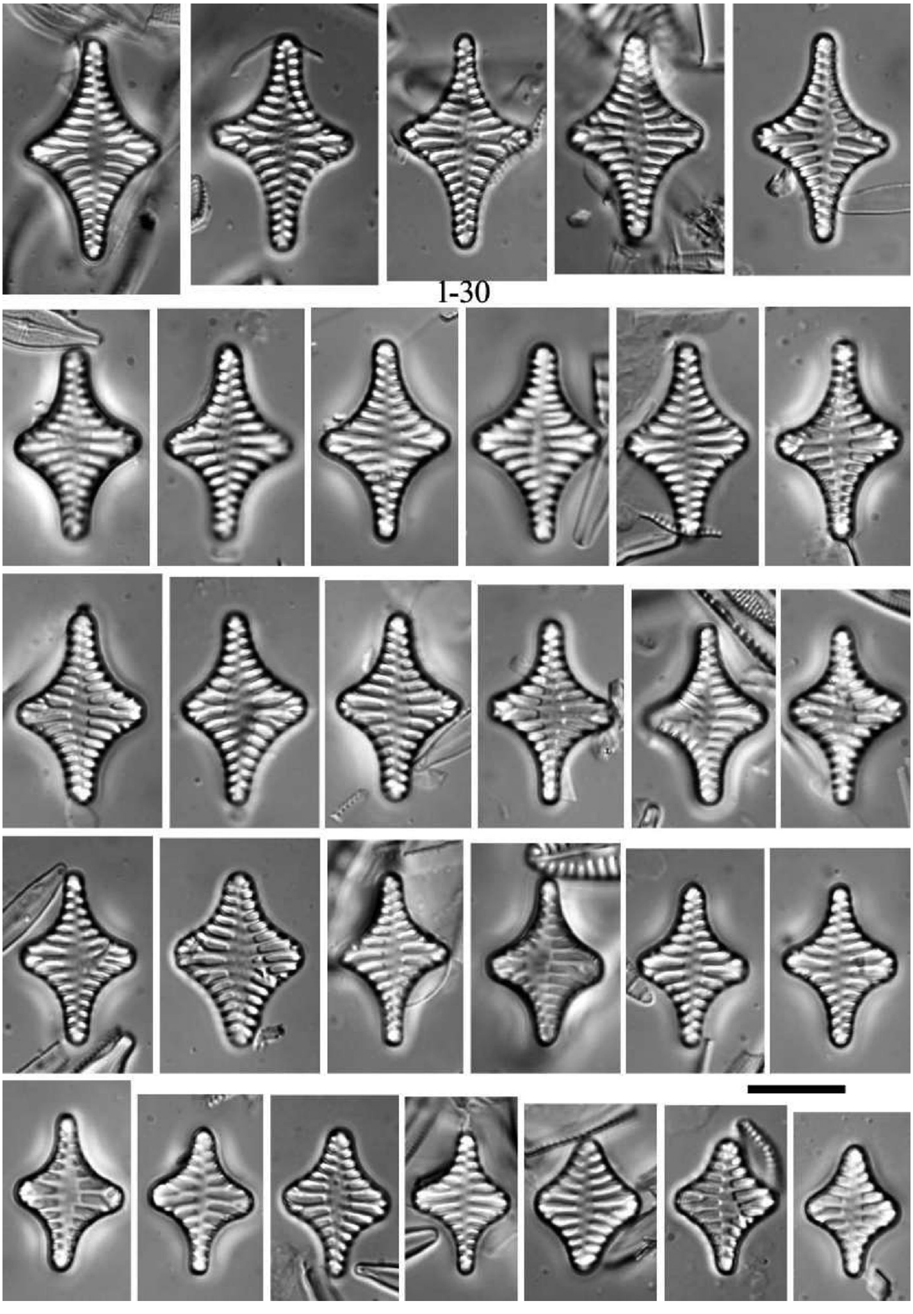

PLATE 28 – *Staurosirella leptostauron* (Ehrenberg) D.M. Williams & F.E. Round (1.–30.).

PLATE 29. *Staurosirella dubia* (Grunow) E.A. Morales & K.M. Manoylov

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Figs 1–41. *Staurosirella dubia* (Grunow) E.A. Morales & K.M. Manoylov
Frustules in girdle view are rectangular and form ribbon-like colonies, joined by linking spines. Valves are elliptic-lanceolate in larger specimens to elliptical in smaller specimens. Valve apices are narrow to broadly rounded. Valve length varies from 12–27 μm, valve width is 6.5–9.0 μm. Valve face is flat, or slightly undulated due to raised costae. The axial area is lanceolate with variable size, from narrow to wide. The striae are distinct, and composed of lineolae gradually decreasing in size from the valve face/mantle edge to central area, 6–8 in 10 μm. Striae vary from parallel in the mid-valve to radiate toward the valve ends. Costae are wider than the striae. Rimoportula is absent. Apical pore fields are present on both ends and located on the valve mantle.

Staurosirella dubia is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–41. Jiuzhaigou National nature reserve, sample Acc. No. 32 – 3J 2016.

PLATE 30. *Staurosirella neopinnata* E.A. Morales, C.E. Wetzel, Haworth & Ector

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Figs 1–49. *Staurosirella neopinnata* E.A. Morales, C.E. Wetzel, Haworth & Ector
Frustules in girdle view are rectangular and form ribbon-like colonies, joined by linking spines. Valves are linear in larger specimens to linear-elliptical in smaller specimens. Initial cells slightly swollen in the mid-valve. Valve apices are narrow to broadly rounded. Valve length varies 12–27 μm, valve width is 6.5–9.0 μm. Valve face is flat or slightly undulate due to raised costae. The axial area is very narrow, linear, central area is absent. The striae are distinct, and composed of lineolae gradually decreasing in size from the valve face/mantle edge to central area, 10–12 in 10 μm. Striae vary from parallel in the mid-valve to radiate toward the valve ends. Costae are wider than the striae. Rimoportula is absent. Apical pore fields are present on both ends and located on the valve mantle.

Staurosirella neopinnata is considered a widely spread (cosmopolitan) species and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–29. Jiuzhaigou National nature reserve, sample Acc. No. 32 – 3J 2016.
Figs 30–49. Jiuzhaigou National nature reserve, sample Acc. No. 66.

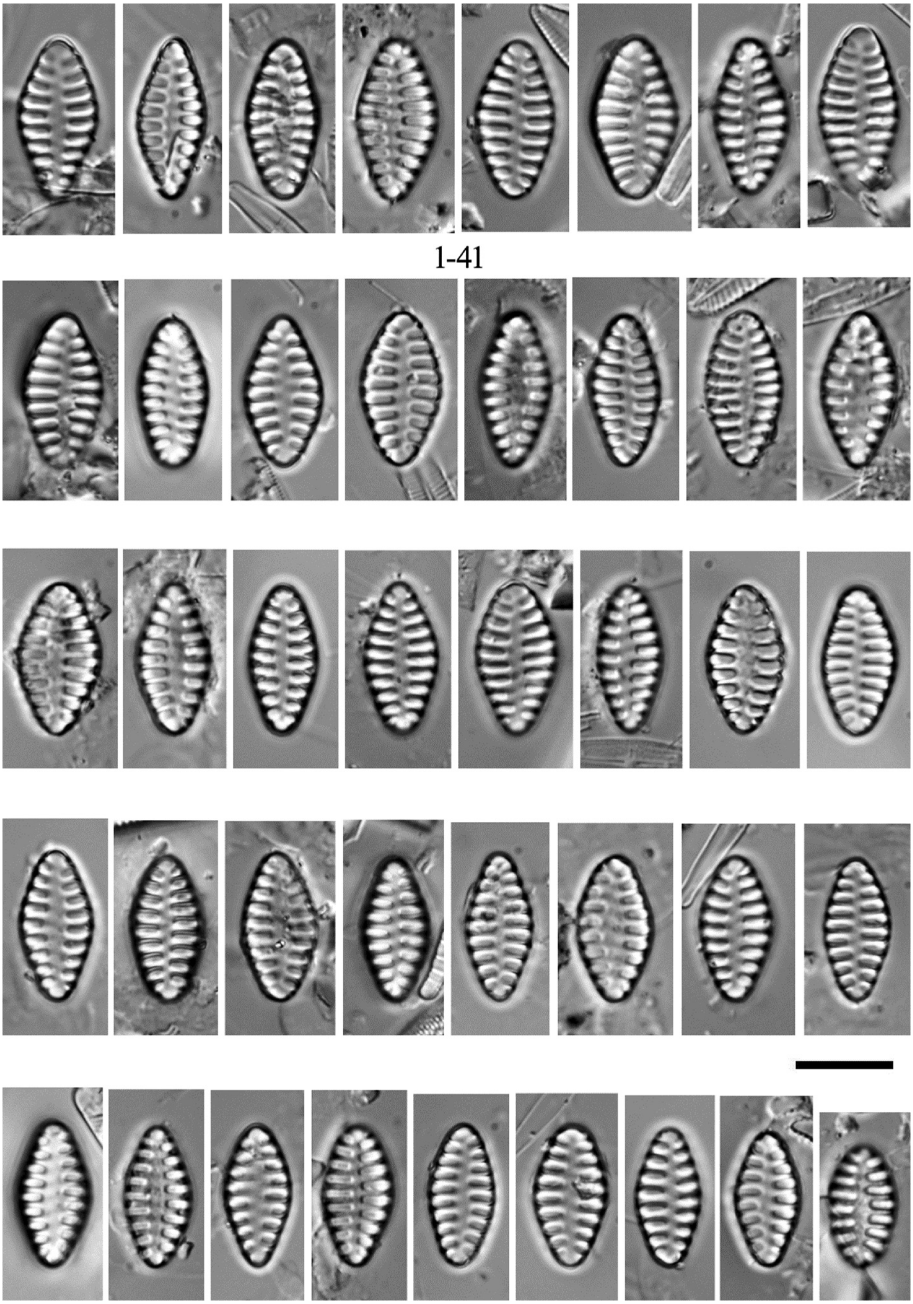

PLATE 29 – *Staurosirella dubia* (Grunow) E.A. Morales & K.M. Manoylov (1.–41.).

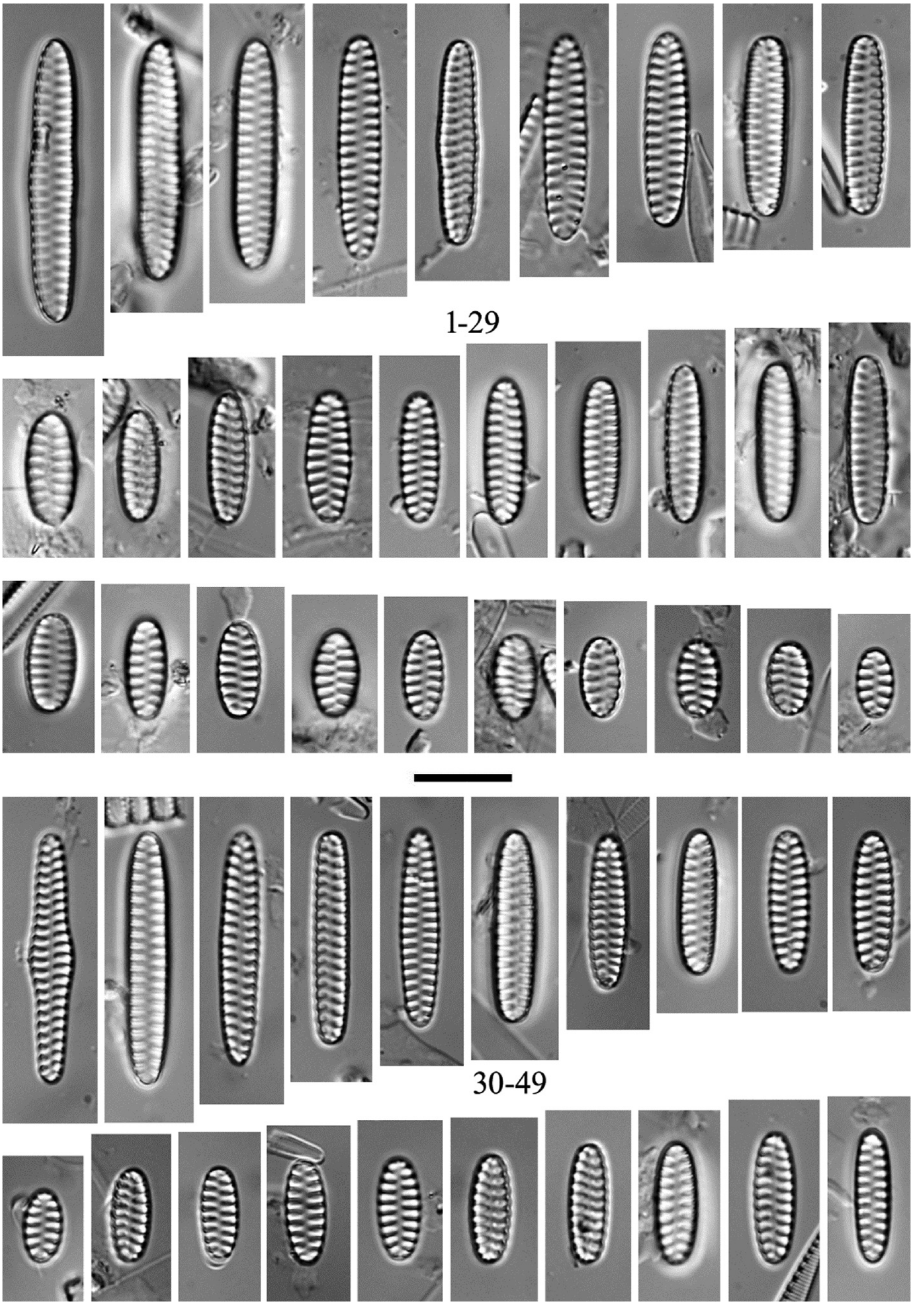

Plate 30 – *Staurosirella neopinnata* E.A. Morales, C.E. Wetzel, Haworth & Ector (1.–49.).

PLATE 31. *Pseudostaurosira microstriata* (Marciniak) Flower, *Pseudostaurosira brevistriata* (Grunow) D.M. Williams & Round

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Figs 1–52. *Pseudostaurosira microstriata* (Marciniak) Flower

Frustules in girdle view are rectangular, joined by linking spines. Valves are linear-lanceolate in larger specimens to elliptical-lanceolate in smaller specimens. Valves ends are rostrate and narrowly rounded. Valve length is 6–15 µm, valve width is wide by 3.0–3.5 µm. The valve face is flat and the transition between the valve face and the mantle is gradual. The axial area is widely lanceolate. Striae are short, distinct, extending onto the mantle, composed of wide, round to oval areolae, 16–18 in 10 µm, parallel to radiate. Costae are broad. Apical pore fields with round poroids are present on the valve mantle close to valve face.

Pseudostaurosira microstriata is considered as a widely spread (cosmopolitan) species and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 53–62. *Pseudostaurosira brevistriata* (Grunow) D.M. Williams & Round

Frustules in girdle view are rectangular, joined by linking spines. Valves are lanceolate in larger specimens to elliptical in smaller specimens. Valves ends are narrowly rounded. Valve length is 16–21 µm, valve width wide by 4.0–5.0 µm. The valve face is flat and the transition between the valve face and the mantle is gradual. The axial area is widely lanceolate. Striae are short, distinct, extending onto the mantle, composed of wide, round to oval areolae, 12–15 in 10 µm, parallel to radiate. Costae are broad. Apical pore fields with round poroids are present on the valve mantle close to valve face. Spines are spatulate and solid.

Pseudostaurosira brevistriata is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 µm
LM 1500x

Figs 1–62. Jiuzhaigou National nature reserve, sample Acc. No. 72 – 2H.

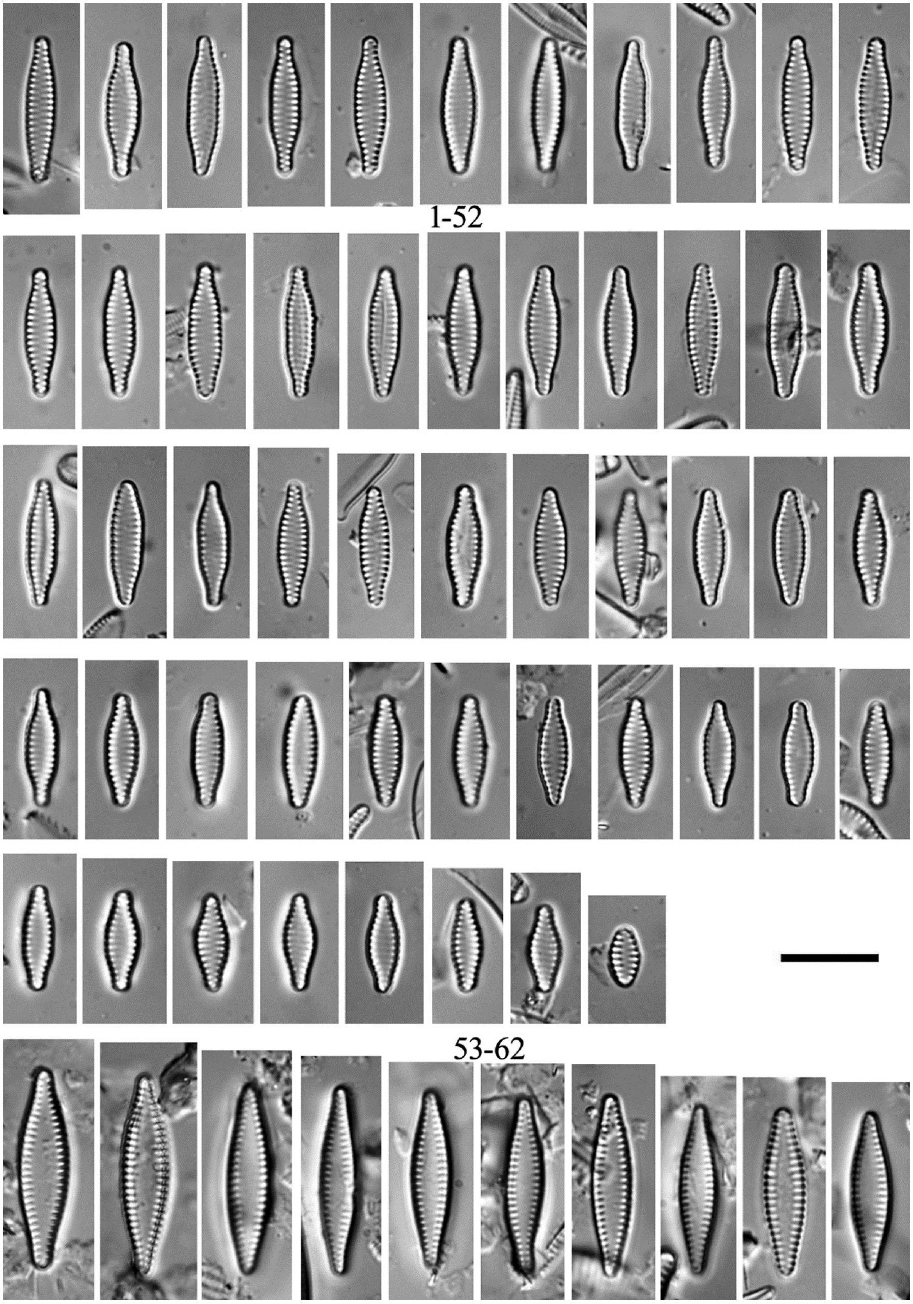

Plate 31 – *Pseudostaurosira microstriata* (Marciniak) Flower (1.–52.), *Pseudostaurosira brevistriata* (Grunow) D.M. Williams & Round (53.–62.).

PLATE 32. *Pseudostaurosira pseudoconstruens* (Marciniak) D.M. Williams & F.E. Round, *Pseudostaurosira robusta* (Fusey) D.M. Williams & F.E. Round, *Pseudostaurosira parasitica* (W. Smith) E. Morales, *Pseudostaurosira* sp. aff. *microstriata* (Marciniak) Flower

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Figs 1–18. *Pseudostaurosira pseudoconstruens* (Marciniak) D.M. Williams & F.E. Round

Frustules in girdle view, rectangular, forming ribbon-like colonies, joined by linking spines. Valves are cruciform, with rounded subcapitate ends. Valves length varies from 6–11 μm, valve width 4.0–5.0 μm, 3.5–4.0 μm in widest part. The axial area is wide and lanceolate. The striae are uniseriate, composed of round, coarse areolae 10–12 in 10 μm. Costae are broad.

Pseudostaurosira pseudoconstruens is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 19–39. *Pseudostaurosira robusta* (Fusey) D.M. Williams & F.E. Round

Frustules in girdle view, rectangular with visible inflation in the middle, forming ribbon-like colonies, joined by linking spines. Valves are linear and bi-undulate, with rounded sub-capitate to capitate ends. Valves length varies from 12–15 μm, valve width in the mid-valve 2.0–3.0 μm, and 3.5–4.0 μm in widest part. The axial area is wide and linear to lanceolate. The striae are uniseriate, composed of round, coarse areolae 14–16 in 10 μm. Costae are broad.

*Pseudostaurosira robust*a is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 40–51. *Pseudostaurosira parasitica* (W. Smith) E. Morales

Frustules in girdle view, rectangular, forming ribbon-like colonies, joined by linking spines. Valves are lanceolate to rhombic-lanceolate, Valve apices are subrostrate to subcapitate ends in larger specimens, cuneate in smaller specimens. Valve length varies from 12–22 μm, valve width is 4.5–5.0 μm. Valve face is flat or slightly undulated due to raised costae. The axial area is widely lanceolate. Striae are distinct, composed of wide, round to oval areolae. Striae parallel to radiate, 18–20 in 10 μm. The costae are broad.

Pseudostaurosira parasitica is considered a widely spread (cosmopolitan) species and it was infrequently observed in the study area.

Figs 52–63. *Pseudostaurosira* sp. aff. *microstriata* (Marciniak) Flower

Scale bar = 10 μm
LM 1500x

Figs 1–63. Jiuzhaigou National nature reserve, various samples.

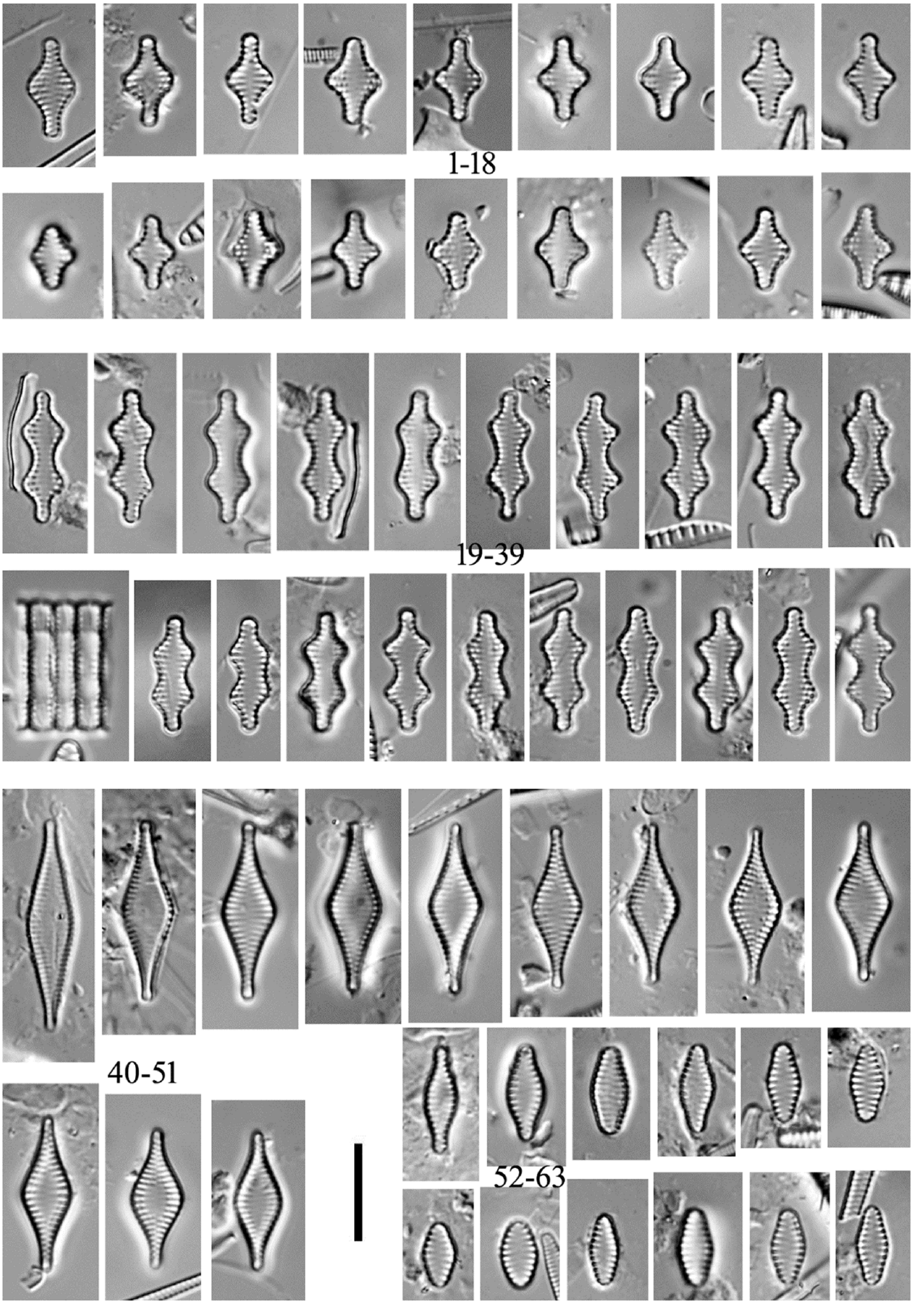

Plate 32 – *Pseudostaurosira pseudoconstruens* (Marciniak) D.M. Williams & F.E. Round (1.–18.), *Pseudostaurosira robusta* (Fusey) D.M. Williams & F.E. Round (19.–39.), *Pseudostaurosira parasitica* (W. Smith) E. Morales (40.–51.), *Pseudostaurosira* sp. aff. *microstriata* (Marciniak) Flower (52.–63.).

PLATE 33. *Achnanthidium* sp. 1. nov.

Figs 1–54. *Achnanthidium* sp. 1. nov.

Frustules are bent in girdle view with a concave raphe valve and a convex rapheless valve. Valves are linear-lanceolate with subcapitate to capitate ends. Valve length was 15–25 μm and the width 3.0–3.5 μm. Axial area on raphe valves is a very narrow, linear axial area, while the axial area rapheless valve is narrow linear, and slightly widened towards the central area. Central area on raphe valve narrow, elliptical, bordered by a few slightly shortened striae, while on rapheless valve is very narrow, weakly differentiated from the axial area. Raphe is linear with expanded central pores. Central striae are more distantly spaced. Striae on both valves slightly radiate in the mid-valve and become more radiate towards the apices, 26–32 in 10 μm at the mid-valve, and up to 35–40 in 10 μm near the apices. Individual areolae were not visible with an LM.

Achnanthidium sp. 1. nov. appears similar to *A. limosua* P. Yu, Q.-M. You & Q.-X. Wang and *A. subtilissimum*, both described alkaline lakes in Jiuzhaigou Nature Reserve, Sichuan Province (Yu *et al.*, 2019). Very likely all these Achnanthidium species represent a species complex (species floc) endemic and characteristic of karstic areas in P.R. China.

Scale bar = 10 μm
LM 1500x

Figs 1–54. Jiuzhaigou National nature reserve, sample Acc. No. 42.

PLATE 34. *Achnanthidium longissimum* P. Yu, Q.-M. You & J.P. Kociolek, *Achnanthidium* sp., *Achnanthidium jiuzhaienis* P. Yu, Q.-M. You & Q.-X. Wang, *Achnanthidium* sp. 2. nov.

Figs 1–12. *Achnanthidium longissimum* P. Yu, Q.-M. You & J.P. Kociolek

Frustules are bent in girdle view with a concave raphe valve and a convex rapheless valve. Valves are linear-lanceolate with capitate to subcapitate ends. Raphe valve is concave and rapheless valve is convex. Valve length 42–52 μm, breadth 3.5–4.5 μm. Axial are in both valves is linear-lanceolate, slightly widened near the central area. Central area on rapheless valve is very narrow and transapically elliptical. Central area on raphe valve small, elliptical, bordered with slightly shortened central striae. Raphe is linear with expanded central pores. Striae nearly parallel on both valves, 22–25 in 10 μm at the centre, up to 30–33 in 10 μm near the apices. Areolae are not visible with an LM.

Achnanthidium longissimum was described from alkaline lakes in Jiuzhaigou Nature Reserve, Sichuan Province (Yu *et al.*, 2018). According to Yu *et al.* (2018), this species was known only from the type locality. This species is probably endemic to P.R. China, characteristic of karstic waters.

Figs 13–15. *Achnanthidium* sp.

Figs 16–24. *Achnanthidium jiuzhaienis* P. Yu, Q.-M. You & Q.-X. Wang

Frustules are bent in girdle view with a concave raphe valve and a convex rapheless valve. Valves are lanceolate to slightly rhombic-lanceolate with subcapitate to capitate ends. The raphe valve is concave and the rapheless valve is convex. Valve length is 26–35 μm, width is 3.0–4.5 μm. Axial area on both valves is narrowly linear-lanceolate, slightly widened towards the mid-valve. Central area is not well defined, very narrow, elliptical bordered by slightly shortened central striae. Striae on both valves radiate to nearly parallel, 22–28 in 10 μm and up to 30–38/10 μm near the apices on the raphe valve. Areolae are not visible with an LM.

Achnanthidium jiuzhaienis was described from alkaline lakes in Jiuzhaigou Nature Reserve, Sichuan Province (Yu *et al.*, 2019). According to Yu *et al.* (2019), this species was known only from the type locality. This species is probably endemic to P.R. China, characteristic of karstic waters.

Figs 25–35. *Achnanthidium* sp. 2. nov.

Scale bar = 10 μm.
LM 1500x

Figs 1–35. Jiuzhaigou National nature reserve, various samples.

PLATE 35. *Achnanthidium pyrenaicum* (Hustedt) H. Kobayasi

Figs 1–49. *Achnanthidium pyrenaicum* (Hustedt) H. Kobayasi

Frustules are bent in girdle view with a concave raphe valve and a convex rapheless valve. Valves are linear-lanceolate to lanceolate with narrowly rounded ends. Valves are often slightly asymmetrical about a median transapical axis. The raphe valve is concave and the rapheless valve is convex. Valve length is 10–23 μm, width is 2.5–4.0 μm. Axial area on raphe valves is narrowly linear-lanceolate, slightly widened towards the mid-valve. Axial area on rapheless valve is very narrow, and linear. Central area on raphe valve is variable, slightly differentiated to asymmetrical (unilateral fascia) to rectangular fascia. Central area on rapheless valve is absent. Raphe is linear with expanded central pores. Striae are parallel throughout both valves or very slightly radiate in the mid-valve and slightly convergent at the apices, 20–25 in 10 μm in the mid-valve and up to 34–40 in 10 μm near apices. Areolae are not visible with an LM.

Achnanthidium pyrenaicum is considered a widely spread (cosmopolitan) species and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–49. Jiuzhaigou National nature reserve, sample Acc. No. D.

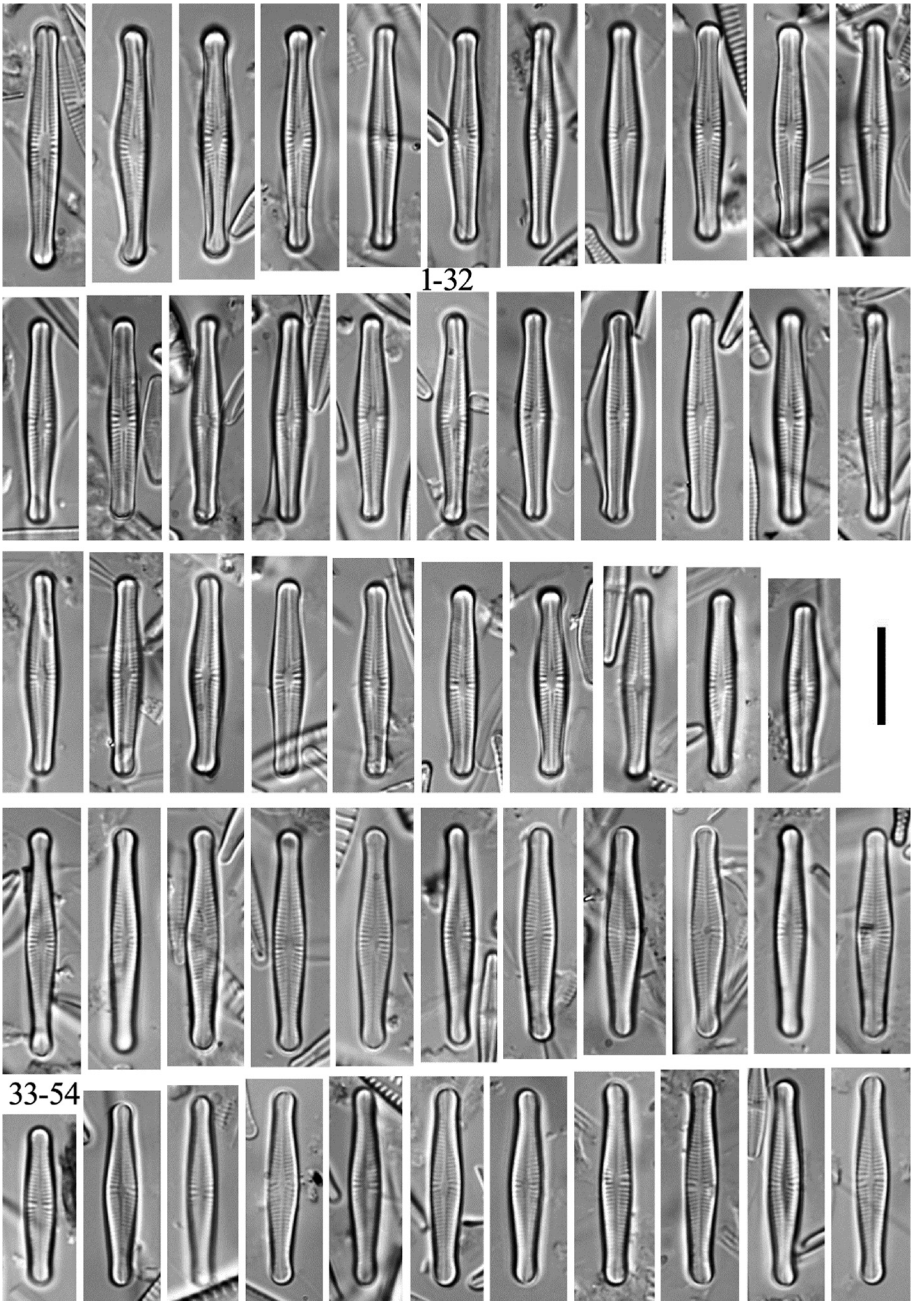

Plate 33 – *Achnanthidium* sp. 1. nov. (1.–54.).

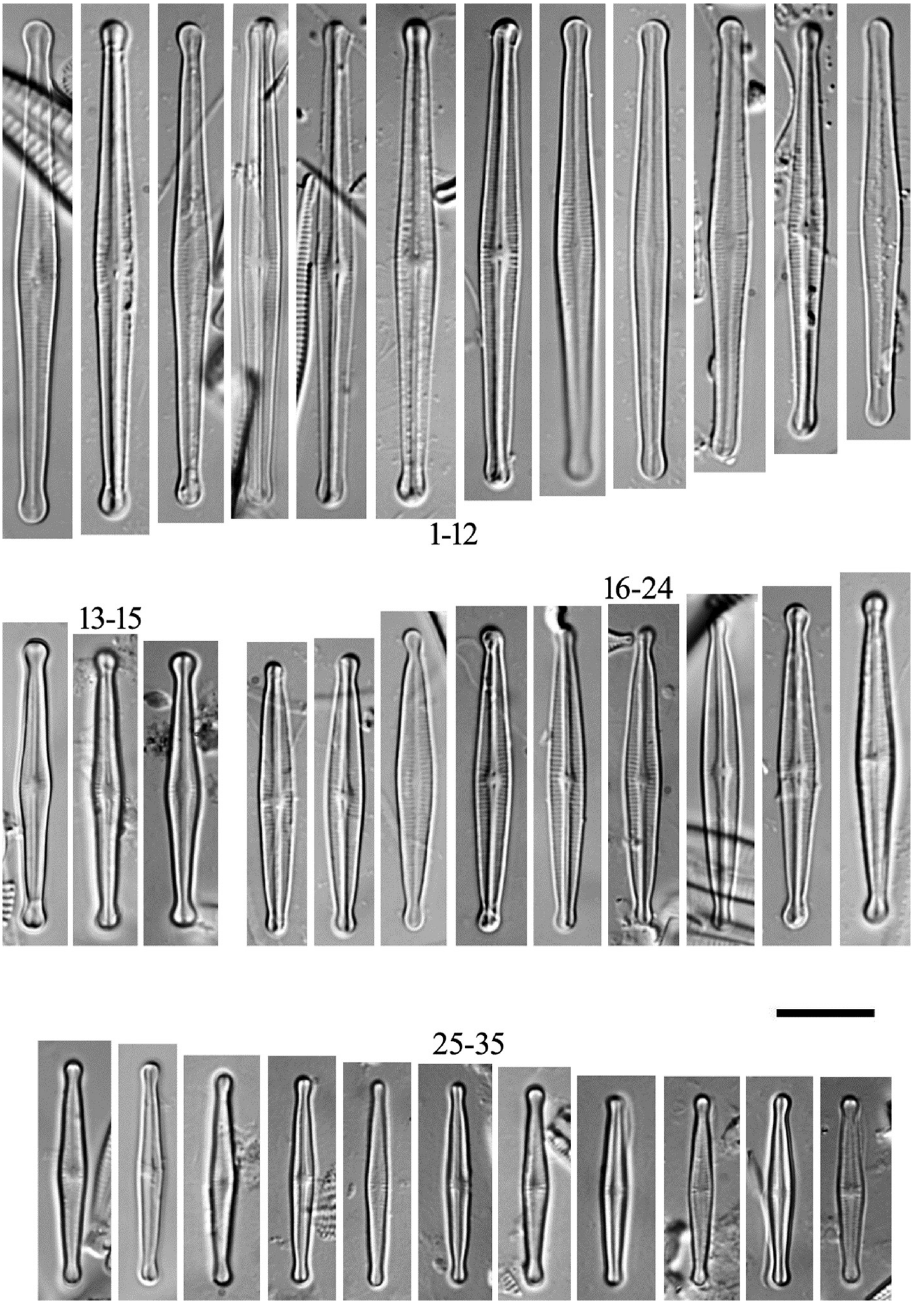

Plate 34 – *Achnanthidium longissimum* P. Yu, Q.-M. You & J.P. Kociolek (1.–12.), *Achnanthidium* sp. (13.–15.), *Achnanthidium jiuzhaienis* P. Yu, Q.-M. You & Q.-X. Wang (16.–24.), *Achnanthidium* sp. 2. nov. (25.–35.).

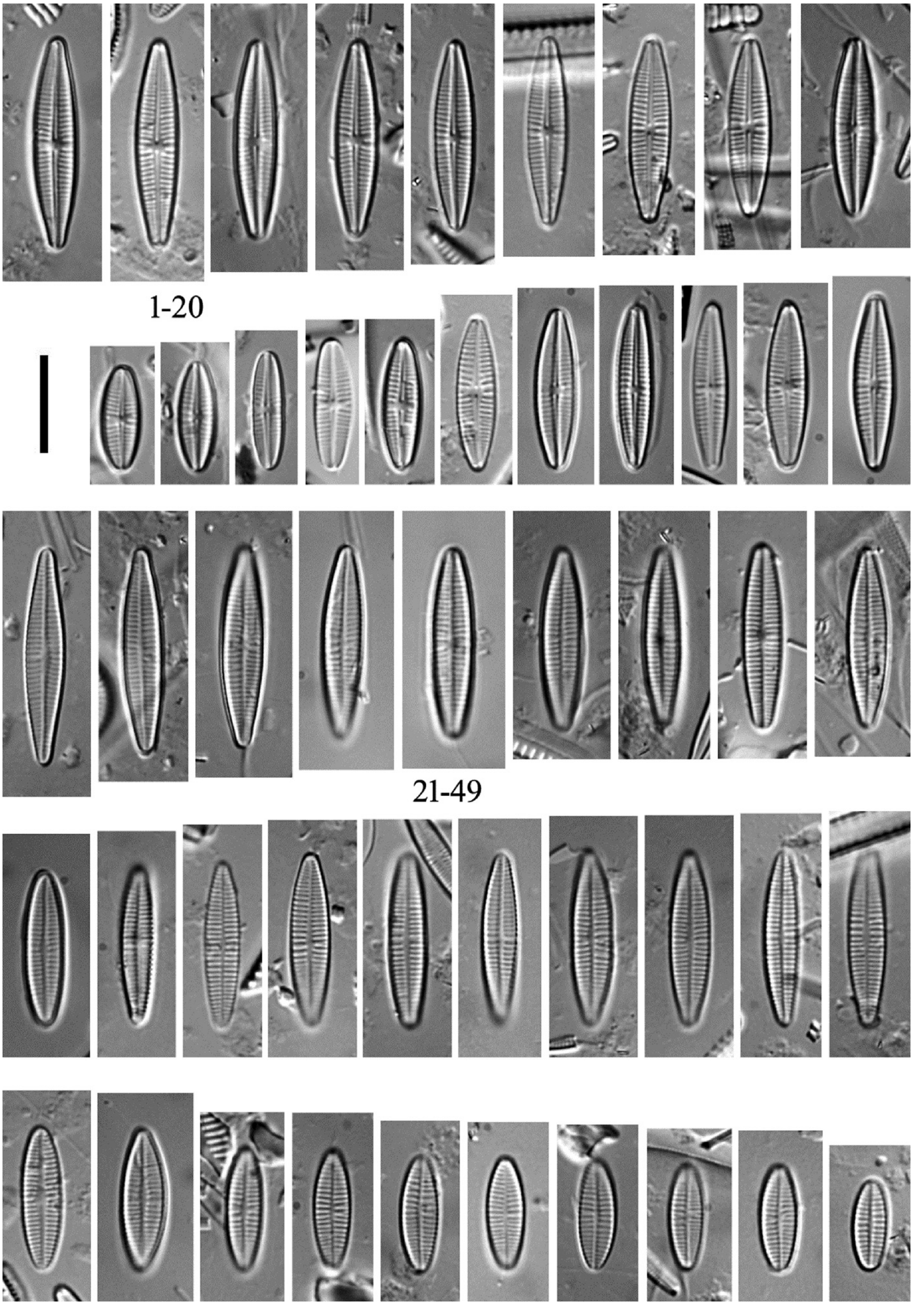

PLATE 35 – *Achnanthidium pyrenaicum* (Hustedt) H. Kobayasi (1.–49.).

PLATE 36. *Achnanthidium parallelum* J.R. Carter ex Jüttner, D.M. Williams, Ector & C.E. Wetzel, *Planothidium frequentissimum* (Lange-Bertalot) Lange-Bertalot, *Planothidium delicatulum* (Kützing) Round & Bukhtiyarova, *Achnanthidium trinode* Ralfs, *Platessa ziegleri* (Lange-Bertalot) Lange-Bertalot, *Kolbesia sichuanenis* P. Yu, Q.-M. You & Q.-X. Wang, *Karayevia clevei* (Grunow) Bukhtiyarova, *Platessa conspicua* (A. Mayer) Lange-Bertalot

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Figs 1–16. *Achnanthidium parallelum* J.R. Carter ex Jüttner, D.M. Williams, Ector & C.E. Wetzel

> Frustules heterovalvar, raphe valve concave, rapheless valve convex. Valves linear with almost parallel to slightly convex margins and broadly rounded apices. Valve length is 11–31 μm, width is 3.5–4.5 μm. Axial area on raphe valves is narrowly linear-lanceolate, slightly widened towards the mid-valve, while on rapheless valve is very narrow, linear-lanceolate. Central area on raphe valve is variable, elliptical, and transapically elongate to slightly irregular, while on rapheless valve is small rounded, sometimes indistinct. Striae are parallel to slightly radiate near the centre and towards apices, 29–32 in 10 μm. Areolae are not visible with an LM.
> *Achnanthidium parallelum* was infrequently observed in the samples from Jiuzhaigou National nature reserve and always with very low abundance.

Fig. 17. *Planothidium frequentissimum* (Lange-Bertalot) Lange-Bertalot
Fig. 18. *Planothidium delicatulum* (Kützing) Round & Bukhtiyarova
Figs 19–21. *Achnanthidium trinode* Ralfs
Figs 22–26. *Platessa ziegleri* (Lange-Bertalot) Lange-Bertalot
Figs 27–32. *Kolbesia sichuanenis* P. Yu, Q.-M. You & Q.-X. Wang

> Frustules are heterovalvar. Valves are linear-lanceolate with central inflation slightly larger than capitate ends. Valve length was 10–14 μm and width 3.0–3.5 μm. Axial area on raphe valve is narrow, linear, and slightly widened near the central area, while axial area on rapheless valve is linear. Central area on raphe valve is small and elliptical, while on rapheless valve is weakly expressed. Striae are slightly radiate throughout both valves, 22–28 in 10 μm in the middle and up to 28–32 in 10 μm near the apices. Areolae are not visible with an LM.
> According to Yu *et al.* (2019), *K. sichuanenis* was known only from the type locality, and probably this species is endemic to karstic areas in P.R. China.

Figs 33–37. *Karayevia clevei* (Grunow) Bukhtiyarova
Figs 38–48. *Platessa conspicua* (A. Mayer) Lange-Bertalot

Scale bar = 10 μm
LM 1500x

Figs 1–48. Jiuzhaigou National nature reserve, various samples.

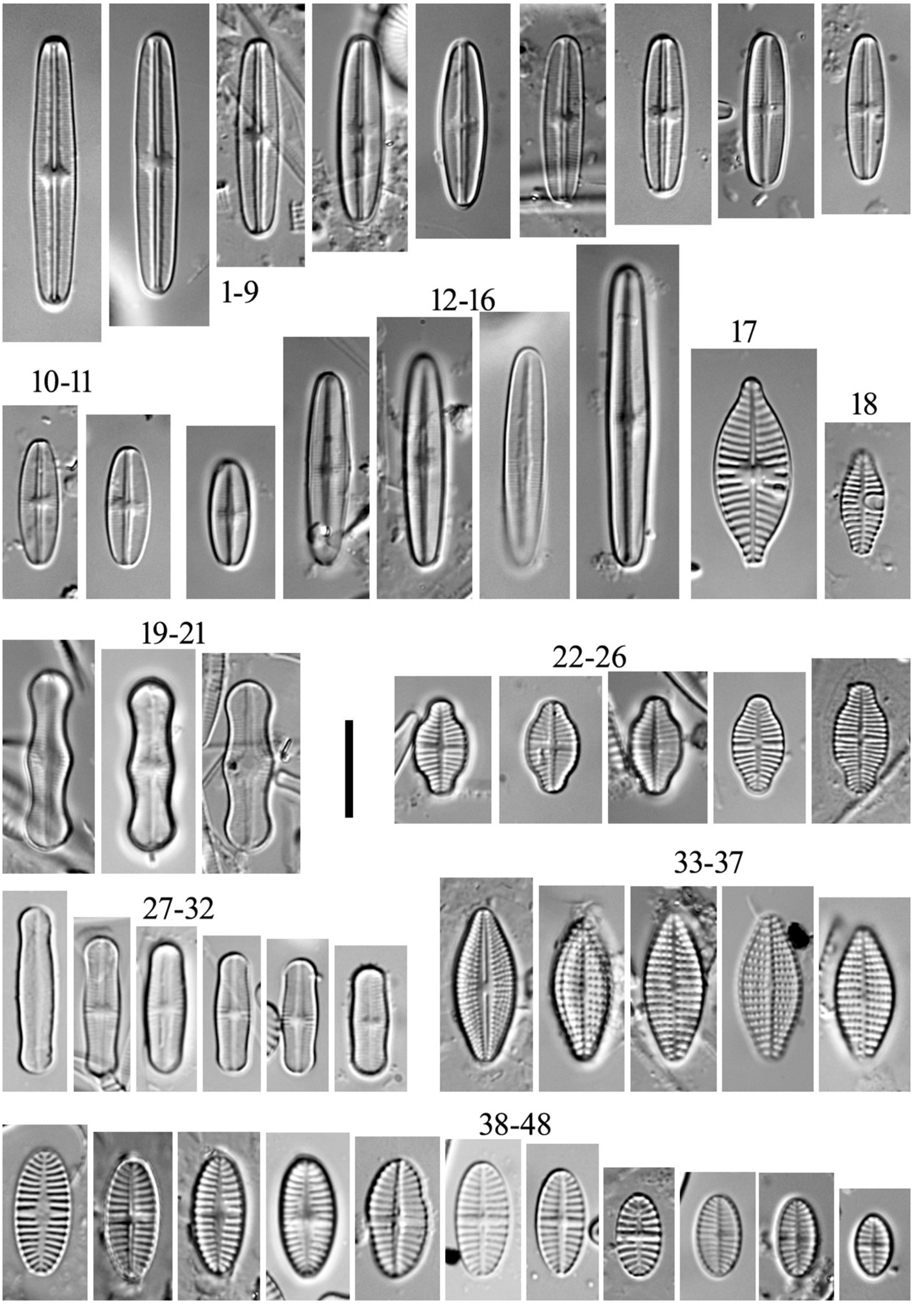

Plate 36 – *Achnanthidium parallelum* J.R. Carter ex Jüttner, D.M. Williams, Ector & C.E. Wetzel (1.–16.), *Planothidium frequentissimum* (Lange-Bertalot) Lange-Bertalot (17.), *Planothidium delicatulum* (Kützing) Round & Bukhtiyarova (18.), *Achnanthidium trinode* Ralfs (19.–21.), *Platessa ziegleri* (Lange-Bertalot) Lange-Bertalot (22.–26.), *Kolbesia sichuanenis* P. Yu, Q.-M. You & Q.-X. Wang (27.–32.), *Karayevia cleve*i (Grunow) Bukhtiyarova (33.–37.), *Platessa conspicua* (A. Mayer) Lange-Bertalot (38.–48.).

PLATE 37. *Eucocconeis flexella* (Kützing) Meister

Figs 1–14. *Eucocconeis flexella* (Kützing) Meister

Frustules in girdle view are strongly bent with concave raphe valve and convex rapheless valve. Valves are elliptical-lanceolate with slightly protracted and broadly rounded ends. Valve face has depressions along the margins. Axial area on raphe valve is narrow axial area slightly widened towards the central area, while axial area on rapheless valve is narrow linear to slightly sigmoid. Central area on raphe valves is lanceolate to rhomboid, on rapheless valve is largely rectangular or hexagonal. The striae are finely punctate, strongly radiate on raphe valve, and slightly radiate on rapheless valve, 22–24 in 10 μm.

Eucocconeis flexella is considered a widely spread (cosmopolitan) species, characteristic of oligotrophic, slightly alkaline waters, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–14. Jiuzhaigou National nature reserve, sample Acc. No. 75 – 4bH.

PLATE 38. *Cocconeis placentula* Ehrenberg, *Cocconeis euglypta* Ehrenberg, *Cocconeis* sp., *Eucocconeis laevis* (Østrup) Lange-Bertalot

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Figs 1–20. *Cocconeis placentula* Ehrenberg

Frustules are heterovalvar. Valves are elliptic to linear-elliptic with broadly rounded ends and flat. Valve length is 12–22 μm, valve width is 7.0–15.0 μm. Axial area on raphe valve is narrow, and linear, while on rapheless valve it is linear-lanceolate. Central area on raphe valve is small, weakly expressed, circular to oval, while it is absent on rapheless valve. The raphe is straight and filiform. Proximal and distal raphe ends are straight and slightly expanded. Striae or raphe valves are radiate and interrupted by a hyaline ring positioned close to the valve margin, 20–24 in 10 μm. The areolae are usually visible under LM, 15–25 in 10 μm. Striae on rapheless valve are coarser 15–20 in 10 μm with 8–15 areolae in 10 μm.

Cocconeis placentula is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 21–24. *Cocconeis euglypta* Ehrenberg

Fig. 25. *Cocconeis* sp.

Figs 26–36. *Eucocconeis laevis* (Østrup) Lange-Bertalot

Frustules in girdle view are strongly bent with a concave raphe valve and convex rapheless valve. Valve length is 13–20 μm, valve width is 5.5–8.0 μm. Valves are lanceolate to elliptic-lanceolate with protracted and broadly rounded ends. Axial area on raphe valve is narrow, linear, and slightly widened near the central area, while on rapheless valve is narrow linear to slightly sigmoid. Central area on raphe valve is asymmetrical, expanded to the valve margin on one side. Central area on rapheless valve is large with variable shape, often asymmetrical an expanded to one or both sides. Striae are finely punctate, radiate, 25–35 in 10 μm.

Eucocconeis laevis is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–36. Jiuzhaigou National nature reserve, various samples.

PLATE 39. *Cocconeis lineata* Ehrenberg

Figs 1–24. *Cocconeis lineata* Ehrenberg

Frustules are heterovalvar, raphe valve slightly concave to flat, rapheless valve convex. Valves are broadly elliptic with narrowly rounded ends and flat. Valve length is 16–35 μm, valve width is 8.0–17.0 μm. Axial area on raphe valve is narrow, and linear, while on rapheless valve it is narrow, lanceolate. Central area on raphe valve is small, weakly expressed, circular to oval, while it is absent on rapheless valve. The raphe is straight and filiform. Proximal and distal raphe ends are straight and slightly expanded, Striae on raphe valve are radiate and interrupted by a hyaline ring positioned close to the valve margin, composed of small dot-like areolae 16–20 in 10 μm. Striae on rapheless valve are coarser composed of transapically elongated areolae, 18–22 in 10 μm. Areolae form slightly irregular, curved longitudinal lines.

Cocconeis lineata is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–24. Jiuzhaigou National nature reserve, sample Acc. No. D.

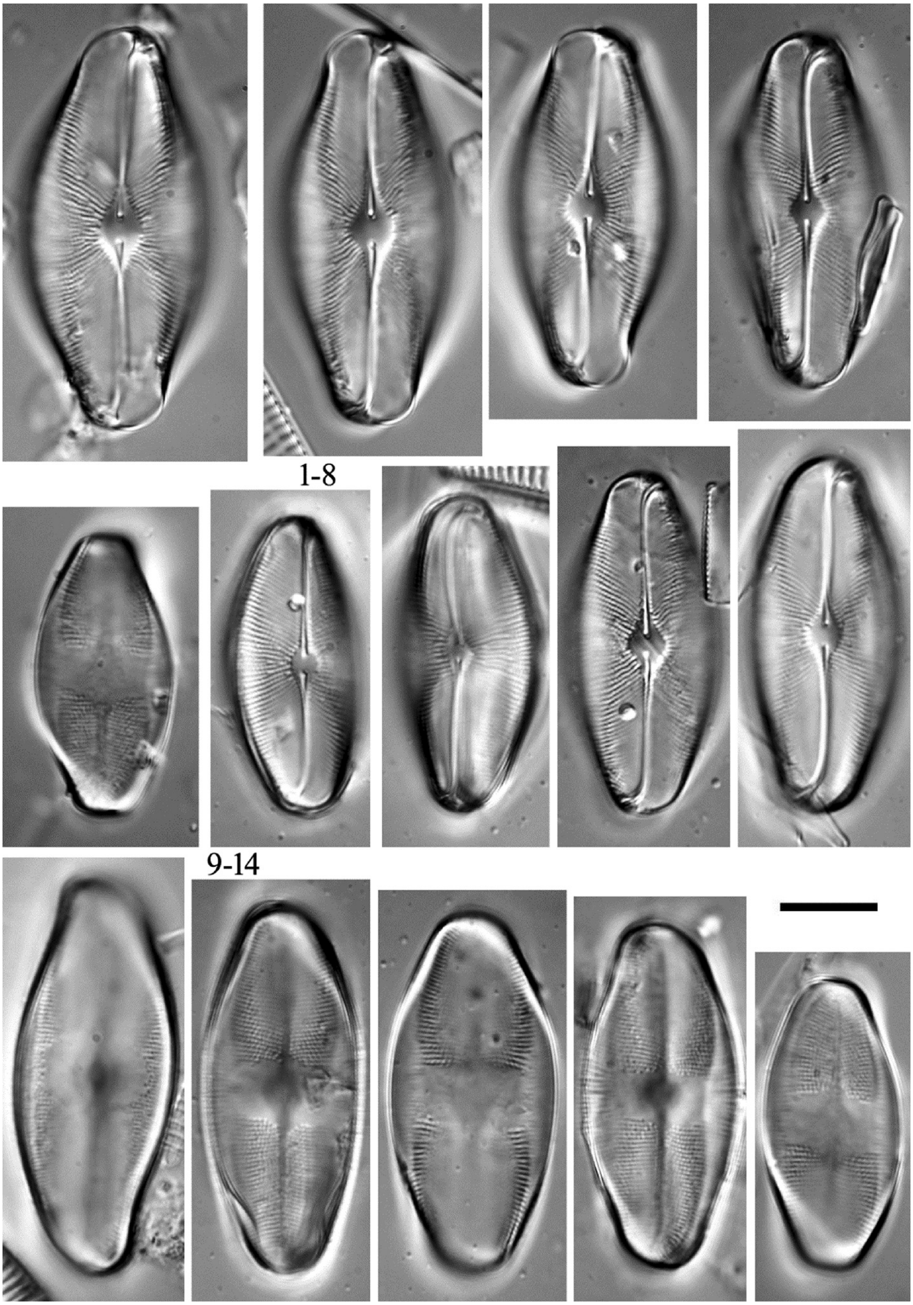

Plate 37 – *Eucocconeis flexella* (Kützing) Meister (1.–14.).

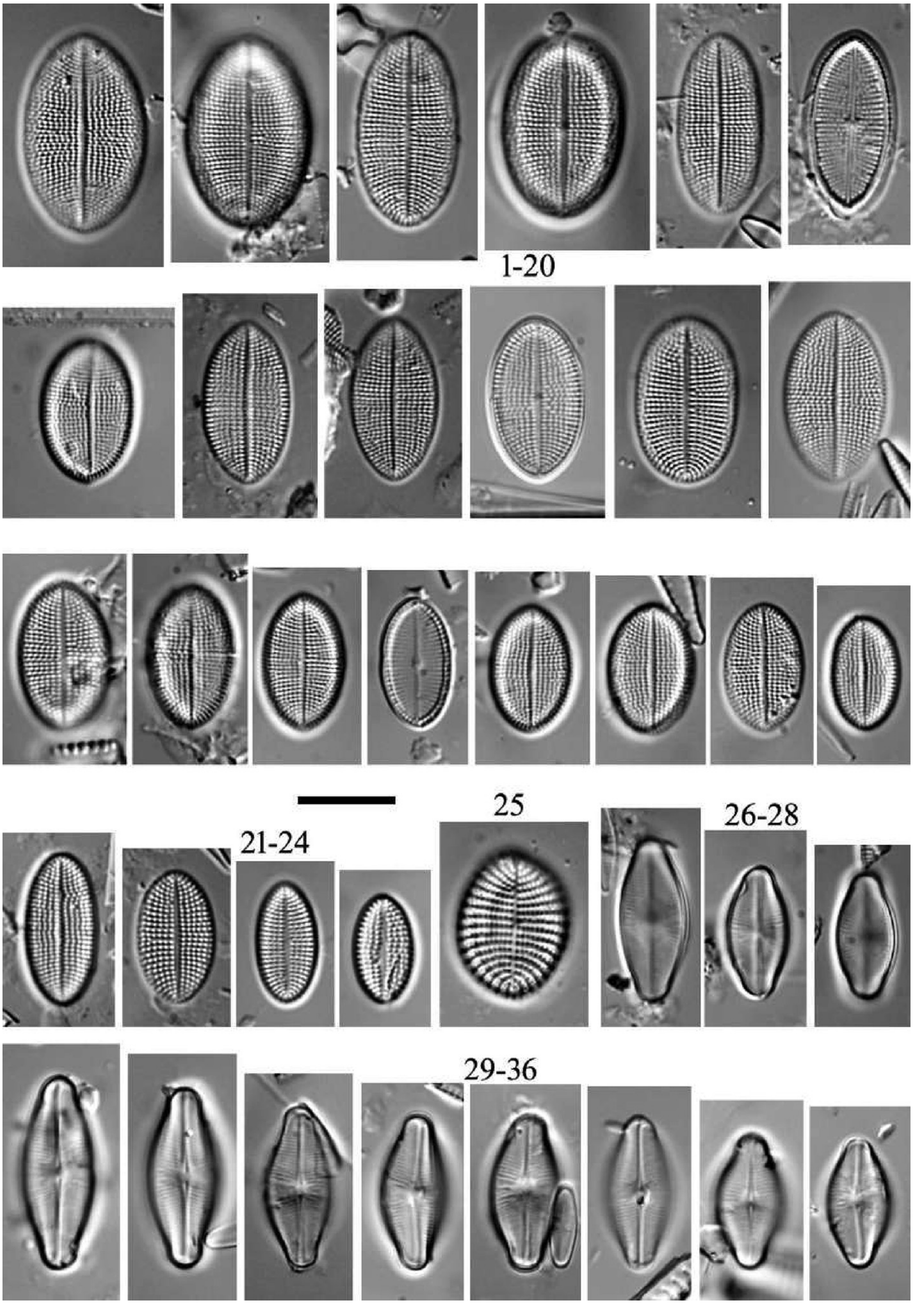

Plate 38 – *Cocconeis placentula* Ehrenberg (1.–20.), *Cocconeis euglypta* Ehrenberg (21.–24.), *Cocconeis* sp. (25.), *Eucocconeis laevis* (Østrup) Lange-Bertalot (26.–36.).

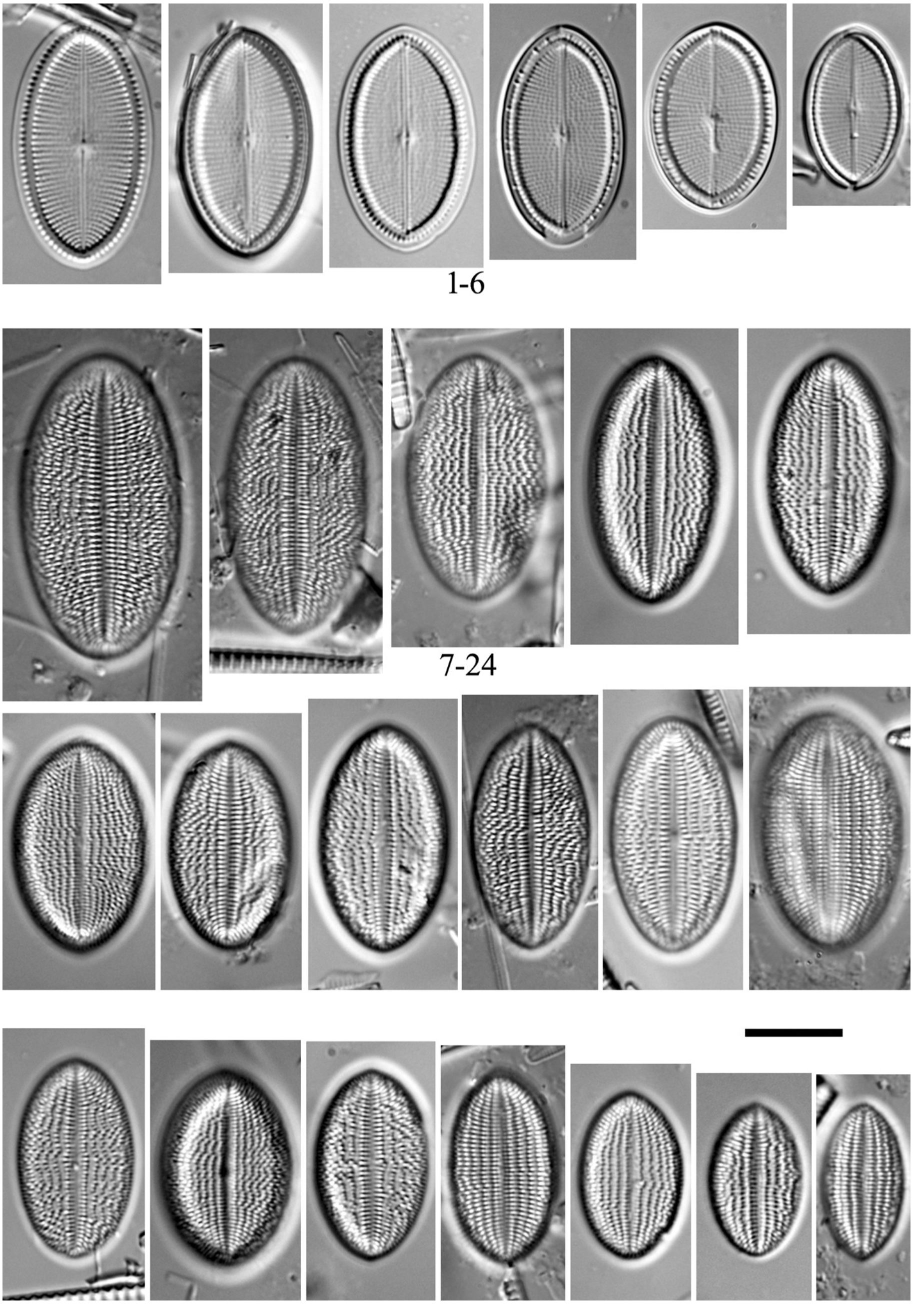

PLATE 39 – *Cocconeis lineata* Ehrenberg (1.–24.).

PLATE 40. *Cocconeis pediculus* Ehrenberg

Figs 1–18. *Cocconeis pediculus* Ehrenberg

The frustule is bent into a saddle shape, with the raphe valve concave and rapheless valve convex. Valves are broadly elliptic to subcircular with curved to slightly pointed apices. Valve length is 20–35 μm, valve width is 13–23 μm. Axial area of the raphe valve is narrow, linear, slightly widened near the central area, while on rapheless valve is very narrow, linear. Central area on raphe valve is small, and irregular to elliptical, on rapheless valve it is absent. Raphe is linear, filiform. Proximal and distal raphe ends are straight. Striae in the mid-valve are parallel, becoming more radiate and curved closer to the apices. On the raphe valve, the striae end before reaching the valve margin, forming a hyaline ring, which is wider on the sides of the valve than at the apices. Striae continue to the valve margin on the rapheless valve. Areolae are small and punctate on the raphe valve, and there are 17–24 areolae in 10 μm. On the rapheless valve, the areolae are narrow and transapically elongate, 6–11 in 10 μm on the rapheless valve.

Cocconeis pediculus is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–18. Jiuzhaigou National nature reserve, sample Acc. No. D.

PLATE 41. *Eunotia flexuosa* (Brébisson) Kützing, *Eunotia valida* Hustedt, *Eunotia glacialifalsa* Lange-Bertalot, *Eunotia arcubus* Nörpel-Schempp & Lange-Bertalot, *Eunotia ruzickae* Bily & Marvan

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Fig. 1. *Eunotia flexuosa* (Brébisson) Kützing
LM 1200x
Figs 2–5. *Eunotia valida* Hustedt

Valves are curved, with dorsal valve margin strongly convex, and ventral valve margin weakly concave. Valve ends are weakly protracted, and broadly rounded. Valve length 64–86 μm and valve breadth 4.0–6.0 μm. Striae parallel at mid-valve, becoming radiate at valve apices. Terminal raphe fissures quite long, terminated close to dorsal valve margin, often recurved towards valve centre. Terminal nodules large, and positioned slightly distant from valve apices. Sternum quite narrow, vaguely discernible in LM view, quite short and close to ventral valve margin before merging with it. Striae evenly spaced throughout, 10–14 in 10 μm at mid-valve and denser at valve apices 14–17 in 10 μm. Areolae clearly discernible in LM view, densely spaced within a stria ca. 40 in 10 μm.

Eunotia valida is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 6. *Eunotia glacialifalsa* Lange-Bertalot

Figs 7, 8. *Eunotia arcubus* Nörpel-Schempp & Lange-Bertalot

Valves strongly curved with clearly protracted, broadly rounded, and subcapitate to capitate valve ends. Dorsal margin strongly convex and ventral strongly concave. Valve margins almost parallel. Valve length 62–70 μm and valve breadth 7.0–7.5 μm as measured in the middle. Terminal raphe fissures short, terminated before mid-point of valve apex. Terminal nodules small. Sternum quite narrow and short, but distinguishable in LM view on valve face, positioned close to ventral valve margin. Striae parallel throughout, 9–11 in 10 μm at the middle and densely spaced at valve ends, 11–14 in 10 μm. Areolae densely spaced within a stria and not distinguishable in LM view.

Eunotia arcubus is considered a widely spread (cosmopolitan) species, but in the samples from Jiuzhaigou National, nature reserve was rare.

Fig. 9. *Eunotia ruzickae* Bily & Marvan

Scale bar = 10 μm
LM: Figs 2–9. 1500x

Figs 1–9. Jiuzhaigou National nature reserve, various samples.

PLATE 42. *Eunotia arcus* Ehrenberg

Figs 1–16. *Eunotia arcus* Ehrenberg

Valves strongly curved with strongly convex dorsal margin and concave ventral margin. In some specimens, valve margins parallel in most of the length. Valve ends slightly to clearly protracted, broadly rounded to abruptly truncate and subcapitate. Valve length 34–64 μm and valve breadth 5.5–8.0 μm as measured in the middle. Terminal raphe fissures short, not expanding beyond mid-point of valve apex. Terminal nodules large, to some extent rectangular in shape. Striae parallel in mid-valve, becoming radiate towards valve apices. Striae are evenly spaced throughout, 9–14 in 10 μm. Areolae densely spaced within a stria, ca. 36 in 10 μm, in some specimens not clearly distinguishable in LM view.

Eunotia arcus is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–16. Jiuzhaigou National nature reserve, sample Acc. No. 32 – 3J.

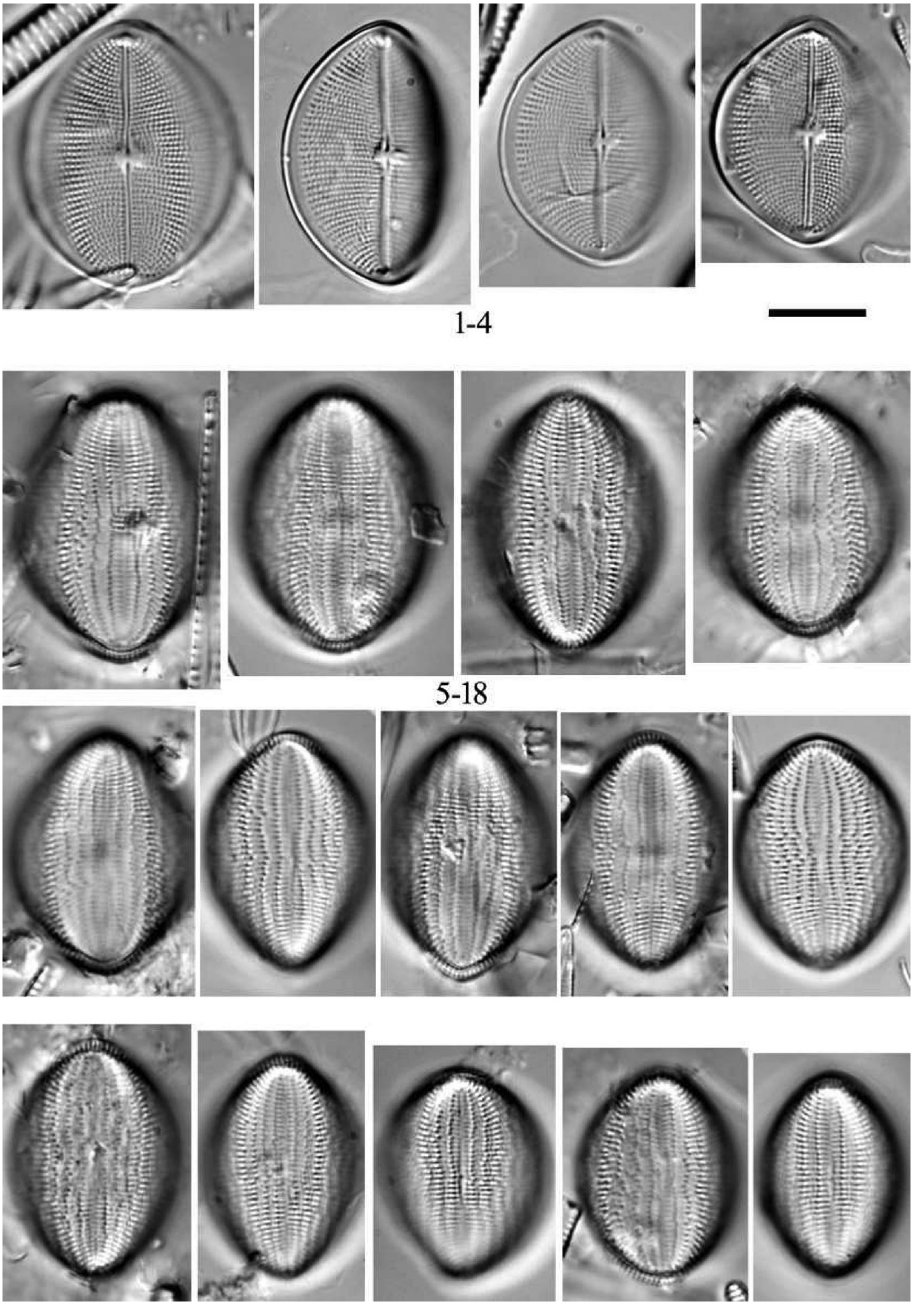

Plate 40 – *Cocconeis pediculus* Ehrenberg (1.–18.).

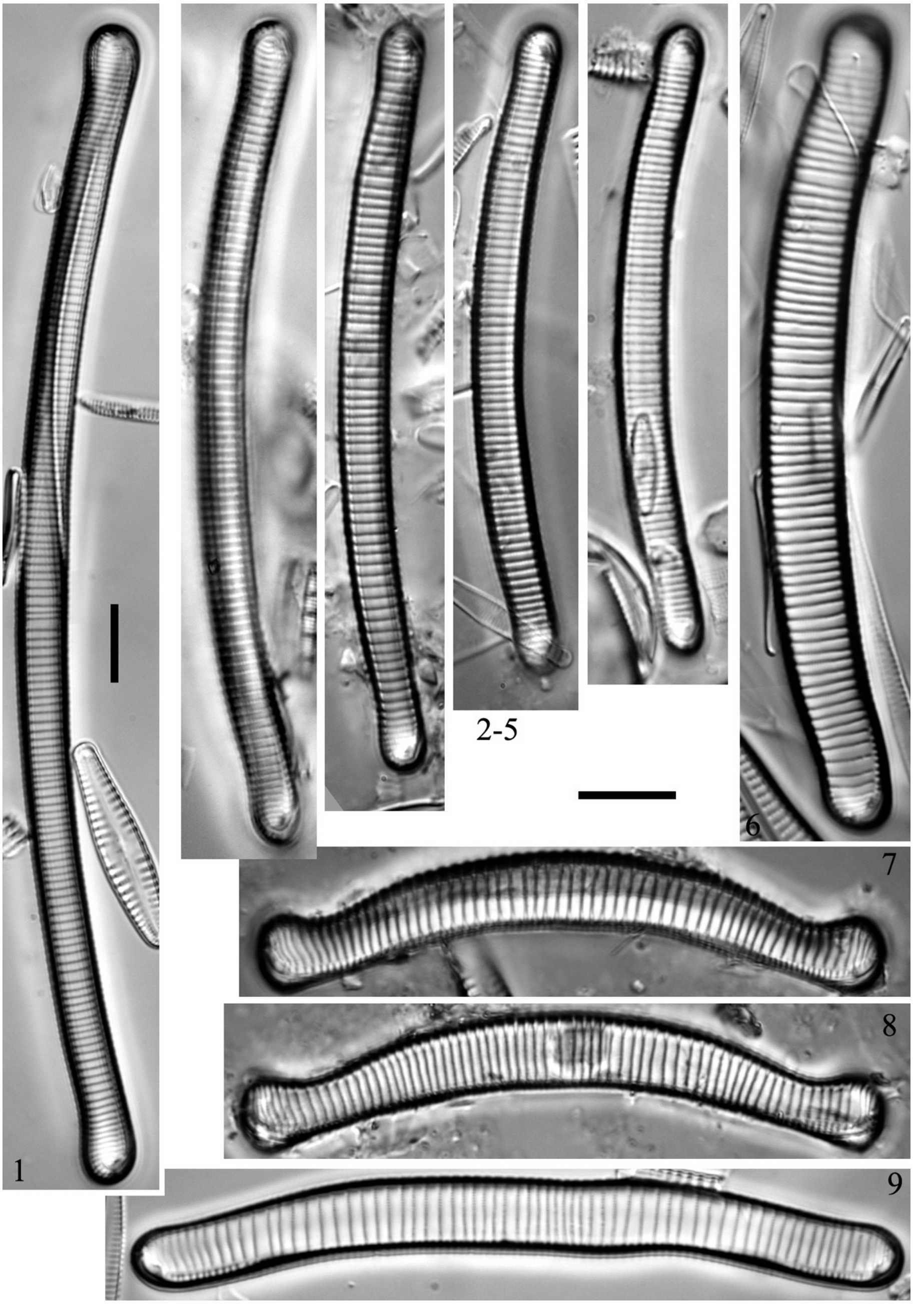

PLATE 41 – *Eunotia flexuosa* (Brébisson) Kützing (1.), *Eunotia valida* Hustedt (2.–5.), *Eunotia glacialifalsa* Lange-Bertalot (6.), *Eunotia arcubus* Nörpel-Schempp & Lange-Bertalot (7., 8.), *Eunotia ruzickae* Bily & Marvan (9.).

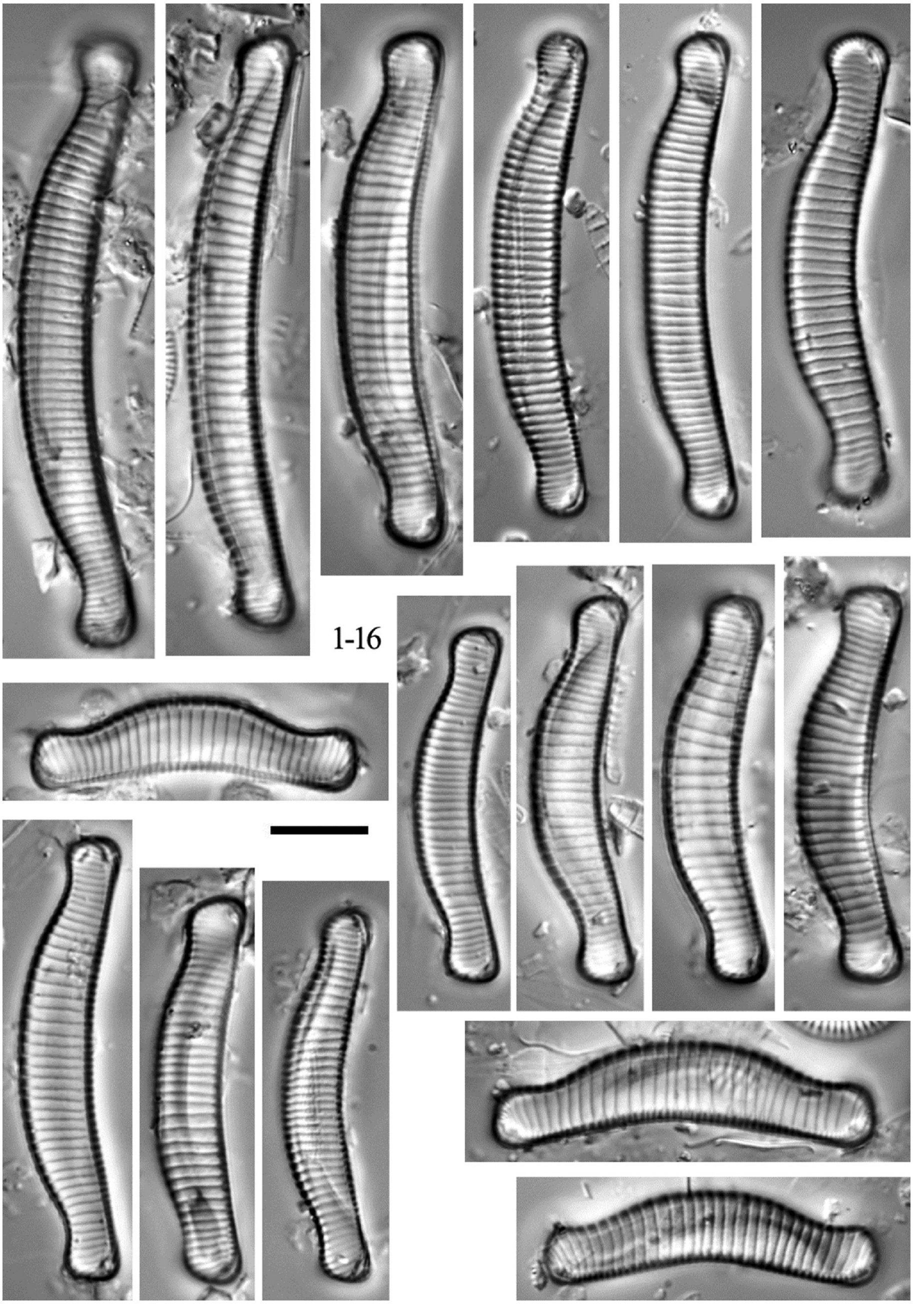

Plate 42 – *Eunotia arcus* Ehrenberg (1.–16.).

PLATE 43. *Eunotia pseudominor* Pavlov & Levkov

Figs 1–22. *Eunotia pseudomino*r Pavlov & Levkov

Valves moderately to weakly curved with slightly protracted, broadly rounded ends. Dorsal valve margin moderately convex, ventral valve margin weakly concave or linear. Valve length 22.0–38 μm and valve breadth 3.5–5.0 μm. Striae parallel, becoming slightly radiate at valve apices. Terminal raphe fissures quite short, slightly curved to linear, rarely extending to mid-point of valve apex. Terminal nodules small, terminally positioned. Rarely terminal nodules slightly distant from valve apices. Proximal raphe ends as well noticeable on ventral valve margin, bellow valve ends. Sternum not distinguishable on valve face in LM view. Striae evenly spaced, 11–15 in 10 μm at mid-valve and 13–17 in 10 μm at valve ends. Areolae quite densely spaced within a stria, not discernible in LM view.

Eunotia pseudominor is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–22. Jiuzhaigou National nature reserve, sample Acc. No. D.

PLATE 44. *Navicula tripunctata* (O.F. Müller) Bory

Figs 1–13. *Navicula tripunctata* (O.F. Müller) Bory

Valves are linear to linear-lanceolate with almost parallel to slightly convex valve margins in the mid-valve. Valve ends not protracted and narrowly rounded. Valve length is 45–56 μm valve width is 7.0–9.0 μm. The axial area is narrow, and linear. Central area is transversely rectangular to elliptical, bordered by 2–3 shortened central striae. The raphe is straight and slightly lateral. Central pores slightly expanded and deflected. Terminal raphe fissure hooked at the apices. The striae are almost parallel to weakly radiate in the middle and slightly convergent at the apices, 9–12 in 10 μm. Areolae 30–33 in 10 μm, hardly visible with LM.

Navicula tripunctata is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–13. Jiuzhaigou National nature reserve, sample Bamboo Lake.

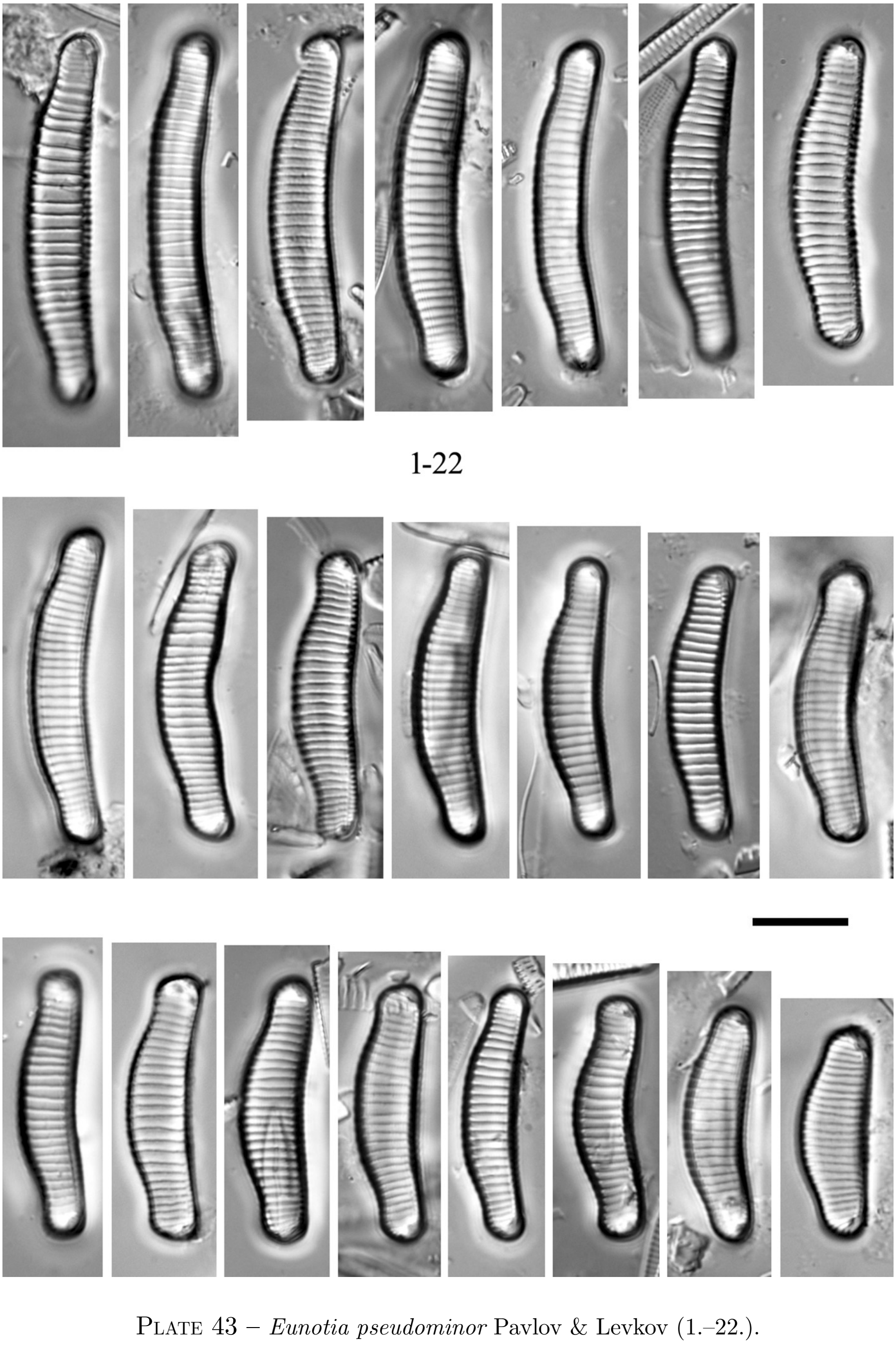

Plate 43 – *Eunotia pseudominor* Pavlov & Levkov (1.–22.).

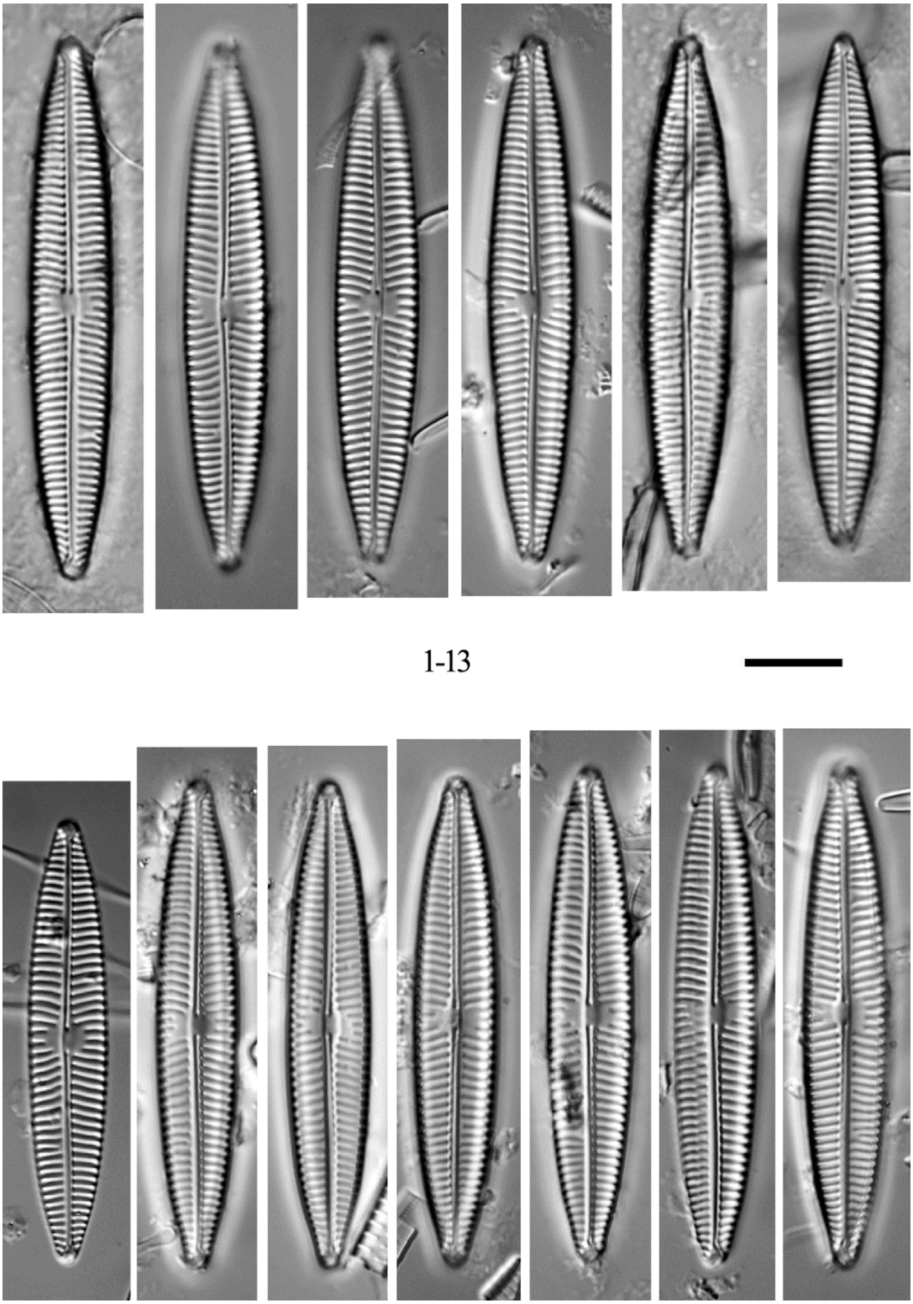

Plate 44 – *Navicula tripunctata* (O.F. Müller) Bory (1.–13.).

PLATE 45. *Navicula radiosa* Kützing

Figs 1–10. *Navicula radiosa* Kützing

Valves are lanceolate to linear-lanceolate with slightly convex valve margins in the mid-valve. Valve ends not protracted and narrowly rounded. Valve length is 64–83 μm valve width is 9.5–12.5 μm. The axial area is narrow, linear, and slightly widened near the central area. Central area is rhombic, bordered by several shortened central striae. The raphe is straight and slightly lateral. Central pores slightly expanded and deflected. Terminal raphe fissure hooked at the apices. The striae almost parallel to weakly radiate in the middle and convergent at the apices, 9–12 in 10 μm. Areolae 28–30 in 10 μm, hardly visible with LM.

Navicula radiosa is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–10. Jiuzhaigou National nature reserve, sample Acc. No. 66.

PLATE 46. *Navicula cryptotenella* Lange-Bertalot

Figs 1–38. *Navicula cryptotenella* Lange-Bertalot

Valves are strictly lanceolate with convex valve margins in the mid-valve. Valve ends not protracted and acutely rounded. Valve length is 15–35 μm valve width is 5.0–7.0 μm. The axial area is narrow, linear, slightly widened near the central area. Central area is small, only slightly expanded, usually rounded and bordered by unequally shortened central striae. The raphe is straight and filiform. Central pores slightly expanded and deflected. Terminal raphe fissure hooked at the apices. The striae are radiate in the mid-valve becoming convergent towards the apices, 14–16 in 10 μm. Areolae 35–38 in 10 μm, hardly visible with LM.

Navicula cryptotenella is considered a widely spread (cosmopolitan) species, and it was one of the most abundant species present in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–38. Jiuzhaigou National nature reserve, sample Acc. No. 42.

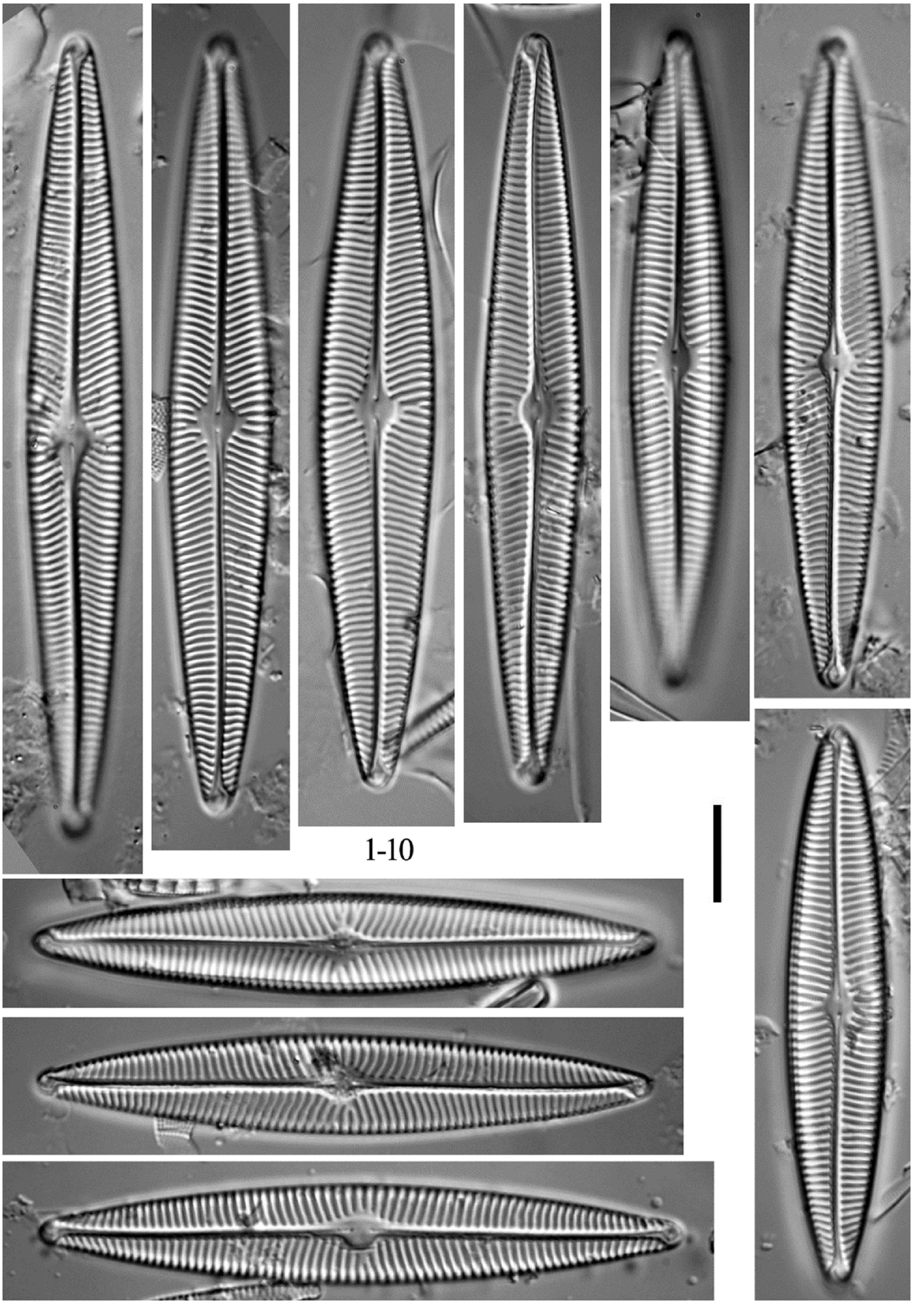

Plate 45 – *Navicula radiosa* Kützing (1.–10.).

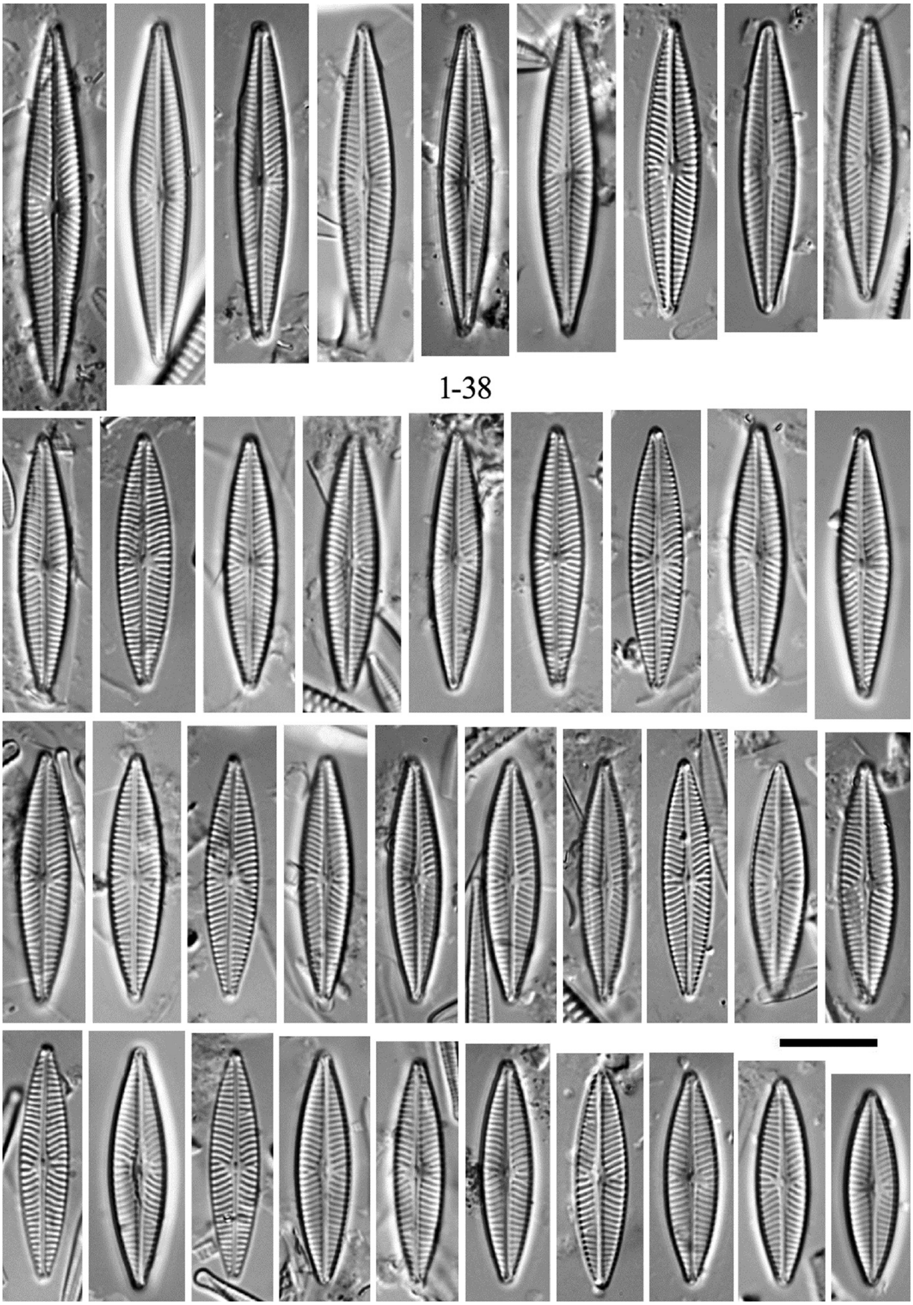

Plate 46 – *Navicula cryptotenella* Lange-Bertalot (1.–38.).

PLATE 47. *Navicula cryptotenelloides* Lange-Bertalot

Figs 1–42. *Navicula cryptotenelloides* Lange-Bertalot

Valves are lanceolate to linear-lanceolate with convex valve margins in the mid-valve. Valve ends not protracted and acutely rounded. Valve length is 15–23 μm valve width is 3.0–5.0 μm. The axial area is narrow, linear, and slightly widened near the central area. Central area is small, only slightly expanded, and bordered by unequally shortened central striae. The raphe is straight and filiform. Central pores slightly expanded and deflected. Terminal raphe fissure hooked at the apices. The striae radiate in the mid-valve becoming convergent towards the apices, 14–16 in 10 μm. Areolae 42–44 in 10 μm, not visible with LM.

Navicula cryptotenelloides is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–21. Jiuzhaigou National nature reserve, sample Acc. No. D.
Figs 22–42. Jiuzhaigou National nature reserve, sample Acc. No. 42.

PLATE 48. *Navicula oligotraphenta* Lange-Bertalot & Hofmann, *Navicula cryptocephala* Kützing, *Navicula praeterita* Hustedt, *Navicula subalpina* E. Reichardt, *Navicula cryptofallax* Lange-Bertalot & Hofmann

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Figs 1, 2. *Navicula oligotraphenta* Lange-Bertalot & Hofmann
Figs 3–6. *Navicula cryptocephala* Kützing

Valves are strictly lanceolate with rostrate to subcapitate ends. Valve length is 27–29 μm valve width is 6.5–7.0 μm. The axial area is narrow, linear, slightly widened near the central area. Central area is small to moderate large, round. The raphe is straight and filiform. Central pores slightly expanded and deflected. Terminal raphe fissure hooked at the apices. The striae radiate in the mid- valve becoming convergent towards the apices, 14–17 in 10 μm. Areolae ca. 40 in 10 μm, not visible with LM.

Navicula cryptocephala is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 7, 8. *Navicula praeterita* Hustedt
Figs 9–19. *Navicula subalpina* E. Reichardt

Valves are strictly lanceolate with protracted ends. Valve length is 25–37 μm valve width is 6.5–7.5 μm. The axial area is narrow, linear, central area is small, and round. The raphe is straight and filiform. Central pores slightly expanded and deflected. The striae strongly radiate in the mid-valve becoming convergent towards the apices, 12–14 in 10 μm. Areolae ca. 30 in 10 μm.

Navicula subalpina is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 20–24. *Navicula cryptofallax* Lange-Bertalot & Hofmann

Valves are strictly lanceolate with capitate ends. Valve length is 26–31 μm valve width is 6.5–7.0 μm. The axial area is narrow, linear, and slightly widened near the central area. Central area is moderately large, round. The raphe is straight and filiform. Central pores slightly expanded and deflected. Terminal raphe fissure hooked at the apices. The striae strongly radiate in the mid-valve becoming convergent towards the apices, 12–14 in 10 μm. Areolae ca. 30 in 10 μm, hardly visible with LM.

Navicula cryptofallax is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–24. Jiuzhaigou National nature reserve, various samples.

PLATE 49. *Navicula pseudoharmoniae* Chudaev

Figs 1–20. *Navicula pseudoharmoniae* Chudaev

Valves linear-lanceolate with broadly rounded, non-protracted, and broadly rounded ends. Valve length 34–55 μm, width 7.0–8.5 μm. Axial area narrowly lanceolate, gradually widening towards mid-valve. Central area rhombic to rhombic-elliptic, not distinctly separated from axial. Central area bordered by alternated short and long striae. Raphe narrowly lateral with straight, drop-like central pores. Terminal fissures curved to the secondary valve side. Raphe slit is distinctly sinuous Striae radiate at valve centre, becoming convergent near the ends, 13–14 in 10 μm. Areolae barely visible with LM, 33–35 in 10 μm.

Navicula pseudoharmoniae was recently described from River Chulyshman, Altai Republic Russia (Chudaev, 2019). Probably it is widely distributed in oligotrophic waters in Asia. In the study is one of the most frequent species.

Scale bar = 10 μm
LM 1500x

Figs 1–20. Jiuzhaigou National nature reserve, sample Acc. No. 42.

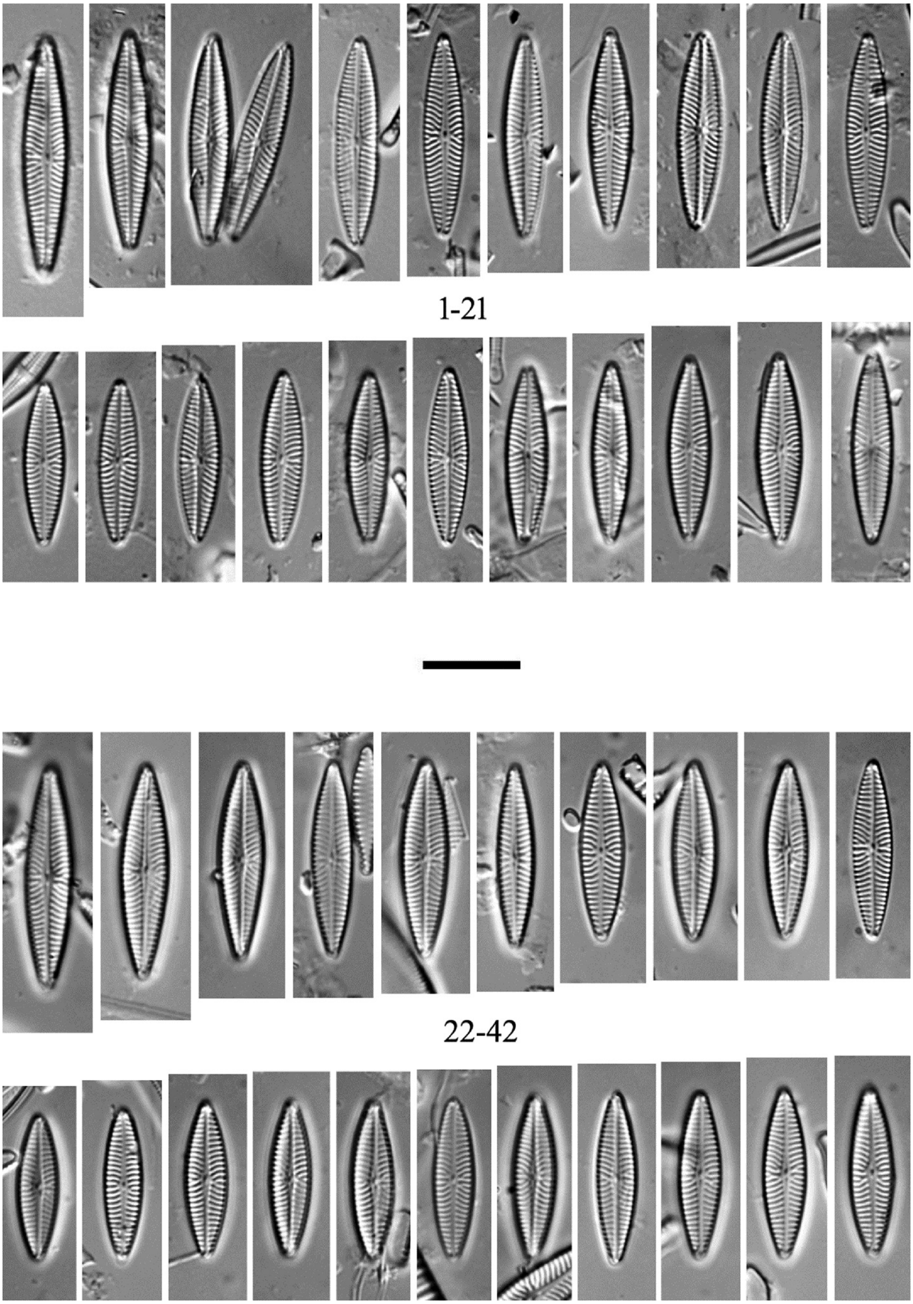

PLATE 47 – *Navicula cryptotenelloides* Lange-Bertalot (1.–42.).

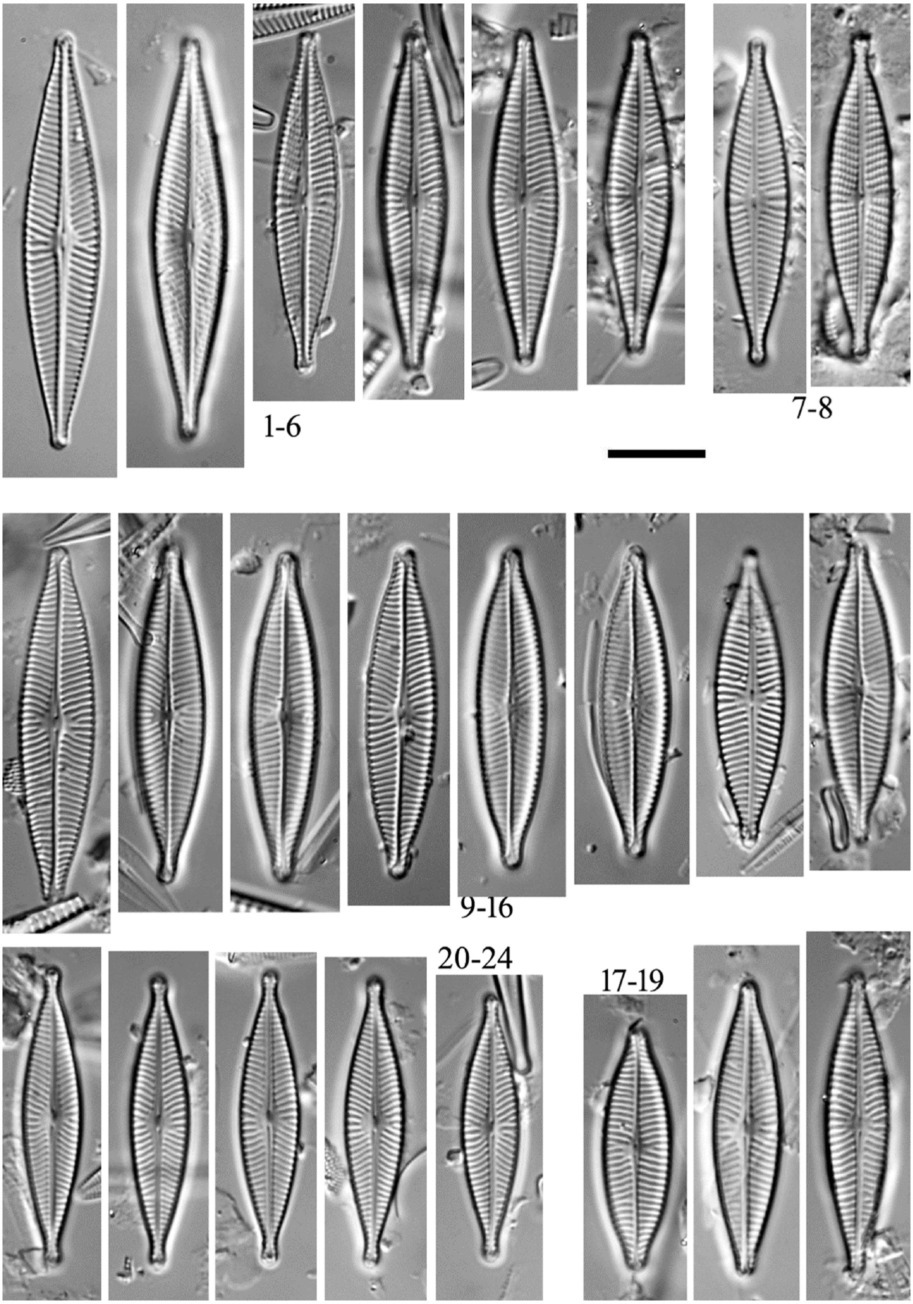

Plate 48 – *Navicula oligotraphenta* Lange-Bertalot & Hofmann (1., 2.), *Navicula cryptocephala* Kützing (3.–6.), *Navicula praeterita* Hustedt (7., 8.), *Navicula subalpina* E. Reichardt (9.–19.), *Navicula cryptofallax* Lange-Bertalot & Hofmann (20.–24.).

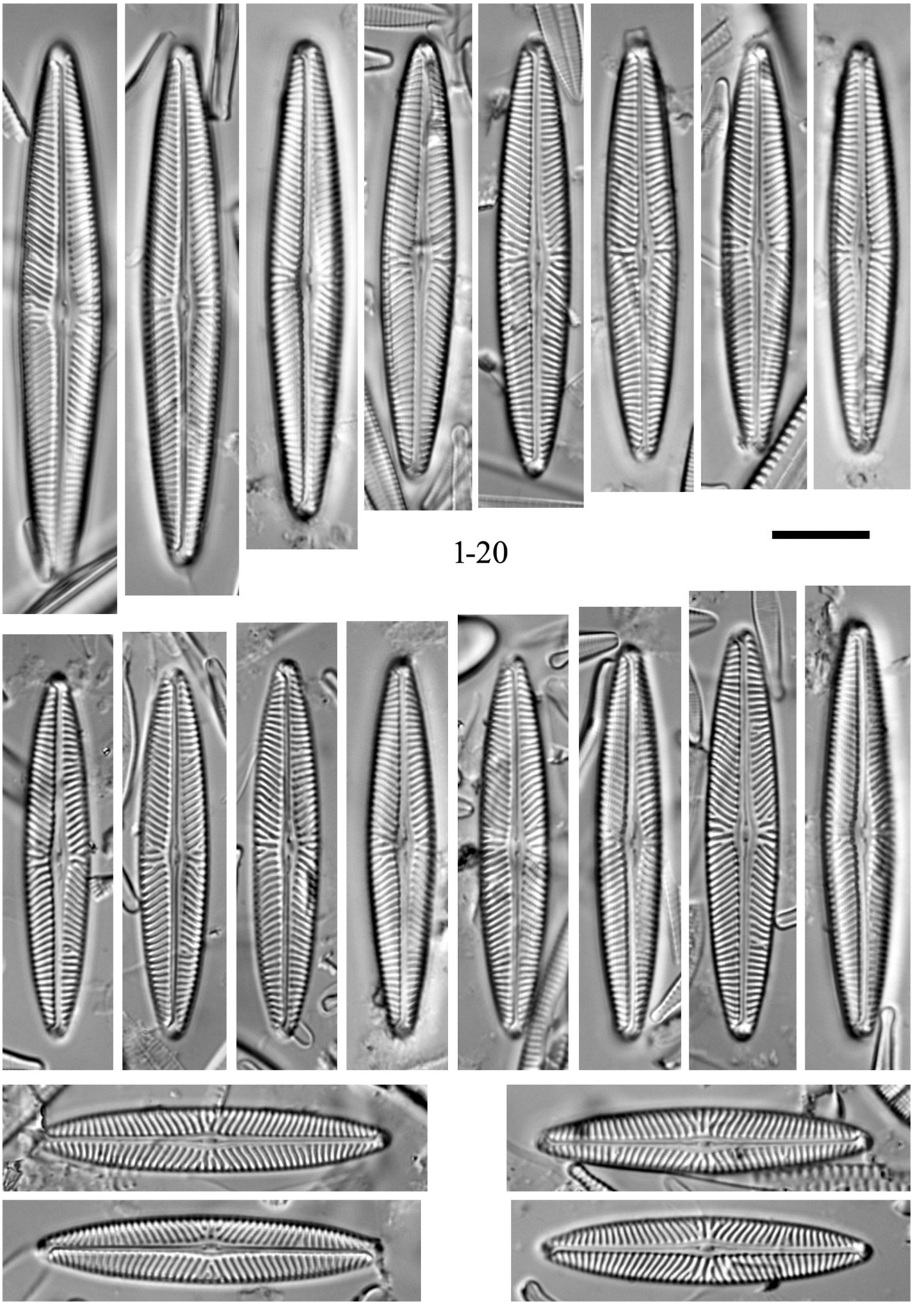

Plate 49 – *Navicula pseudoharmoniae* Chudaev (1.–20.).

PLATE 50. *Navicula scaniae* Van de Vijver, Jarlman & Lange-Bertalot, *Navicula* sp. aff. *cryptocephala* Kützing, *Navicula seibigiana* Lange-Bertalot, *Navicula tenelloides* Hustedt, *Navicula* sp.

Figs 1–9. *Navicula scaniae* Van de Vijver, Jarlman & Lange-Bertalot

Valves are linear-lanceolate to linear with almost parallel to weakly convex margins and broadly rounded and not protracted valve apices. Valve length is 25–41 μm, valve width is 5.0–6.0 μm. Axial area is very narrow, linear, slightly widened near the central area. Central area small, indistinct to variable in shape due to alternating longer and shorter striae around the central area. Raphe filiform, straight near the distal endings and slightly undulated near the central area with proximal ends deflected towards the secondary side. Striae strongly radiate in the middle part of the valves, abruptly becoming convergent towards apices, 12–14 in 10 μm. Lineolae difficult to resolve in LM.

This taxon was recorded by Chudaev (2019) as Navicula scaniae for Altai Region, Metzeltin *et al.* (2009) as *Navicula* spec. aff *digitoconvergens* Lange-Bertalot and Kulikovskiy *et al.* (2016) as *N. scaniae* for Mongolia. Probably it is widely distributed in oligotrophic waters in Asia.

Figs 10–18. *Navicula* sp. aff. *cryptocephala* Kützing

Valves are strictly lanceolate with slightly rostrate and narrowly rounded ends. Valve length is 19–29 μm valve width is 5.5–6.0 μm. The axial area is narrow, and linear. Central area is small, variable in shape due to alternating longer and shorter striae around the central area. The raphe is straight and filiform. Central pores slightly expanded and deflected. Terminal raphe fissure hooked at the apices. The striae radiate in the mid-valve becoming convergent towards the apices, 14–16 in 10 μm. Areolae ca. 40 in 10 μm, not visible with LM.

This taxon is probably widely spread in the study area, but it is confused with *N. cryptocephala.*

Figs 19–22. *Navicula seibigiana* Lange-Bertalot

Fig. 23. *Navicula tenelloides* Hustedt

Figs 24–27. *Navicula* sp.

Scale bar = 10 μm
LM 1500x

Figs 1–27. Jiuzhaigou National nature reserve, various samples.

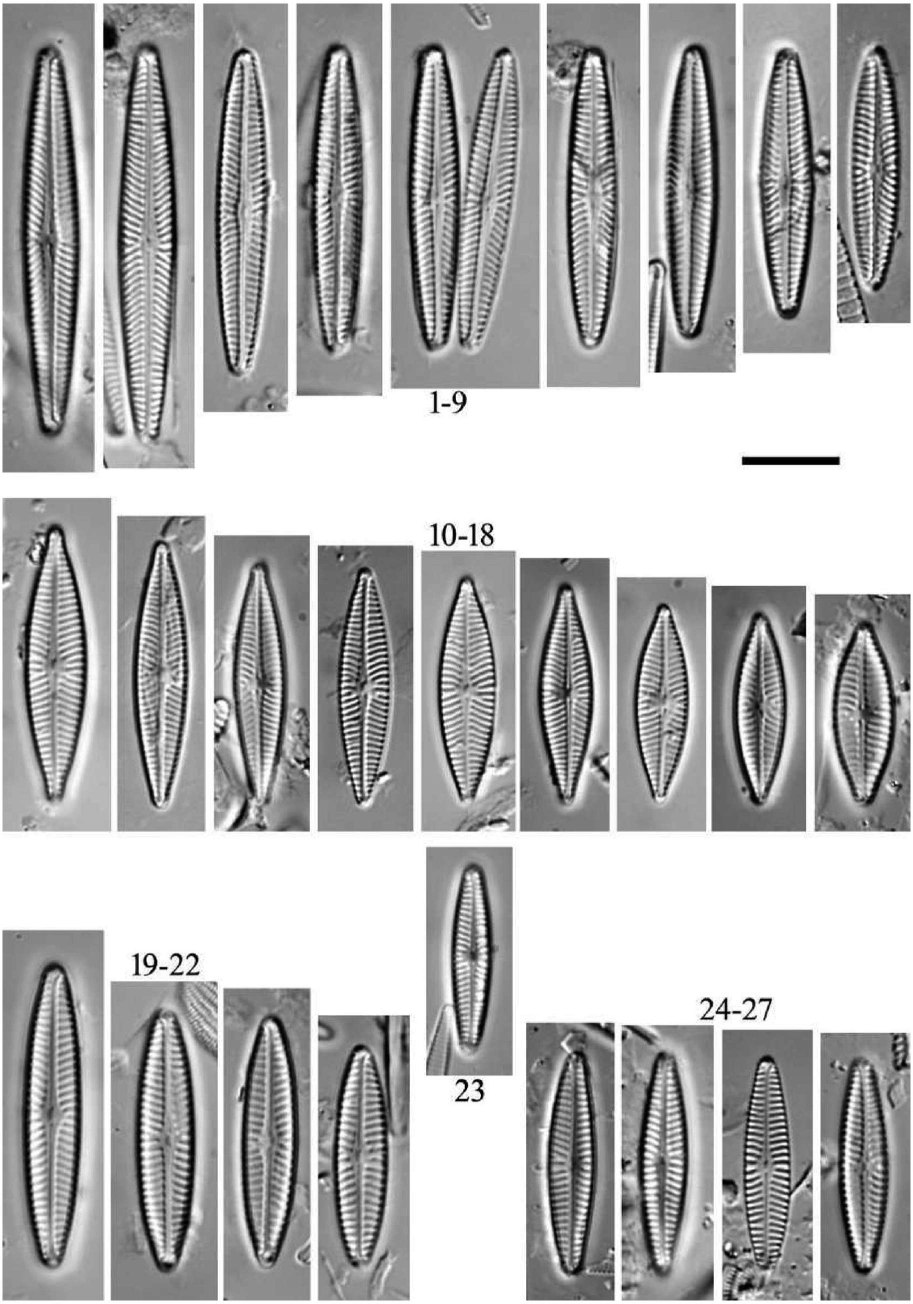

PLATE 50 – *Navicula scaniae* Van de Vijver, Jarlman & Lange-Bertalot (1.–9.), *Navicula* sp. aff. *cryptocephala* Kützing (10.–18.), *Navicula seibigiana* Lange-Bertalot (19.–22.), *Navicula tenelloides* Hustedt (23.), *Navicula* sp. (24.–27.).

PLATE 51. *Navicula peroblonga* Metzeltin, Lange-Bertalot & Soninkhishig, *Navicula oblonga* (Kützing) Kützing, *Navicula* sp.

Figs 1–3. *Navicula peroblonga* Metzeltin, Lange-Bertalot & Soninkhishig

Valves are strictly linear with parallel margins and broadly rounded ends. Valve length is 82–105 μm valve width is 13.5–16.0 μm. The axial area is narrow, and linear. Central area is large, rhombic too. The raphe is straight and lateral. Central pores slightly expanded and deflected. Terminal raphe fissure hooked at the apices. The striae radiate in the mid-valve becoming convergent towards the apices, 7–9 in 10 μm. Areolae are not visible with LM.

According to Metzeltin *et al.* (2009), this species is widely distributed in Asia, but very likely confused with *Navicula oblonga* Kützing. In the study area is rare, and only few specimens have been observed.

Fig. 4. *Navicula oblonga* (Kützing) Kützing

Figs 5–7. *Navicula* sp. 1.

Valves linear to linear-lanceolate with almost parallel valve margins and broadly rounded ends. Valve length is 46–60 μm valve width is 8.0–9.0 μm. The axial area is narrow and linear. The central area is slightly asymmetric, and circular. The raphe is straight and slightly latera, with external proximal raphe ends slightly dilated and bent towards primary side of the valve. The central nodule is asymmetrically expanded towards primary valve side. The striae radiate in the mid-valve becoming convergent towards the apices, 9–10 in 10 μm. Areolae are visible with LM, 25–28 in 10 μm.

Navicula sp. 1 belongs to section Alinea Lange-Bertalot (2001) which is characterized by lower number of species. The most similar taxon is Navicula viridula var. linearis Hustedt (1937) which differs from *Navicula* sp. 1 by the shape of the valve apices and longer valves. In the study area, only few specimens of *Navicula* sp. 1 have been observed. Additional observations are necessary to establish proper identity of *Navicula* sp. 1.

Scale bar = 10 μm
LM 1500x

Figs 1–7. Jiuzhaigou National nature reserve, sample Acc. No. JG P B3.

PLATE 52. *Navicula oligotraphenta* Lange-Bertalot & Hofmann, *Placoneis abiskoensis* (Hustedt) Lange-Bertalot & Metzeltin

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Figs 1–12. *Navicula oligotraphenta* Lange-Bertalot & Hofmann

Valves are strictly lanceolate with margins gradually tapering towards narrowly rounded apices. Valve length is 40–55 μm, valve width is 9.0–10.0 μm. Axial area is very narrow, linear, slightly widened near the central area. Central area moderately large, variable in shape rhombic to round. Raphe straight and weakly lateral. Proximal raphe ends deflected towards the secondary side and expanded into small central pores. Striae strongly radiate in the middle part of the valves, abruptly becoming convergent towards apices, 9–11 in 10 μm. Lineolae coarse, easily to resolve in LM, 25–30 in 10 μm.

Navicula oligotraphenta is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 13, 14. *Placoneis abiskoensis* (Hustedt) Lange-Bertalot & Metzeltin

Valves are linear, with parallel or weakly concave margins. Valve ends are rostrate to sub-capitate. Valve length is 32–34 μm, valve width is 10.0–10.5 μm. Axial area is very narrow and slightly widens near the central area. Central area is large, transversely rectangular. The raphe is weakly lateral and somewhat sinuous. Proximal raphe ends are expanded into distinct central pores and bent to one side. Distal raphe ends are hooked towards the opposite side of the valve. Striae are strongly curved and radiate, 10–11 in 10 μm. Areolae coarse and easy to resolve in LM, 25–30 in 10 μm.

Placoneis abiskoensis is considered widely spread in oligotrophic, cold waters, but in the samples from Jiuzhaigou National, nature reserve was rare.

Scale bar = 10 μm
LM 1500x

Figs 1–14. Jiuzhaigou National nature reserve, sample Bamboo Lake.

PLATE 53. *Adlafia bryophila* (J.B. Petersen) Lange-Bertalot

Figs 1–54. *Adlafia bryophila* (J.B. Petersen) Lange-Bertalot

Valves are linear, with parallel or weakly convex or undulated margins. Valve ends are rostrate to sub-capitate. Valve length is 13–20 μm, valve width is 3.0–4.0 μm. Axial area is very narrow and slightly widens near the central area. Central area is indistinct, only slightly expanded, and bordered by unequally shortened central striae. The raphe is straight and filiform with proximal raphe ends expanded into distinct central pore and bent to one side. Distal raphe ends are curved towards the opposite side of the valve. Striae strongly radiate in the middle, becoming strongly divergent towards apices, 30–36 in 10 μm. Areolae not recognizable with LM.

Adlafia bryophila is considered widely spread in oligotrophic, cold waters, and in the samples from Jiuzhaigou National nature reserve was very abundant.

Scale bar = 10 μm
LM 1500x

Figs 1–54. Jiuzhaigou National nature reserve, sample Acc. No. 33 – 2J.

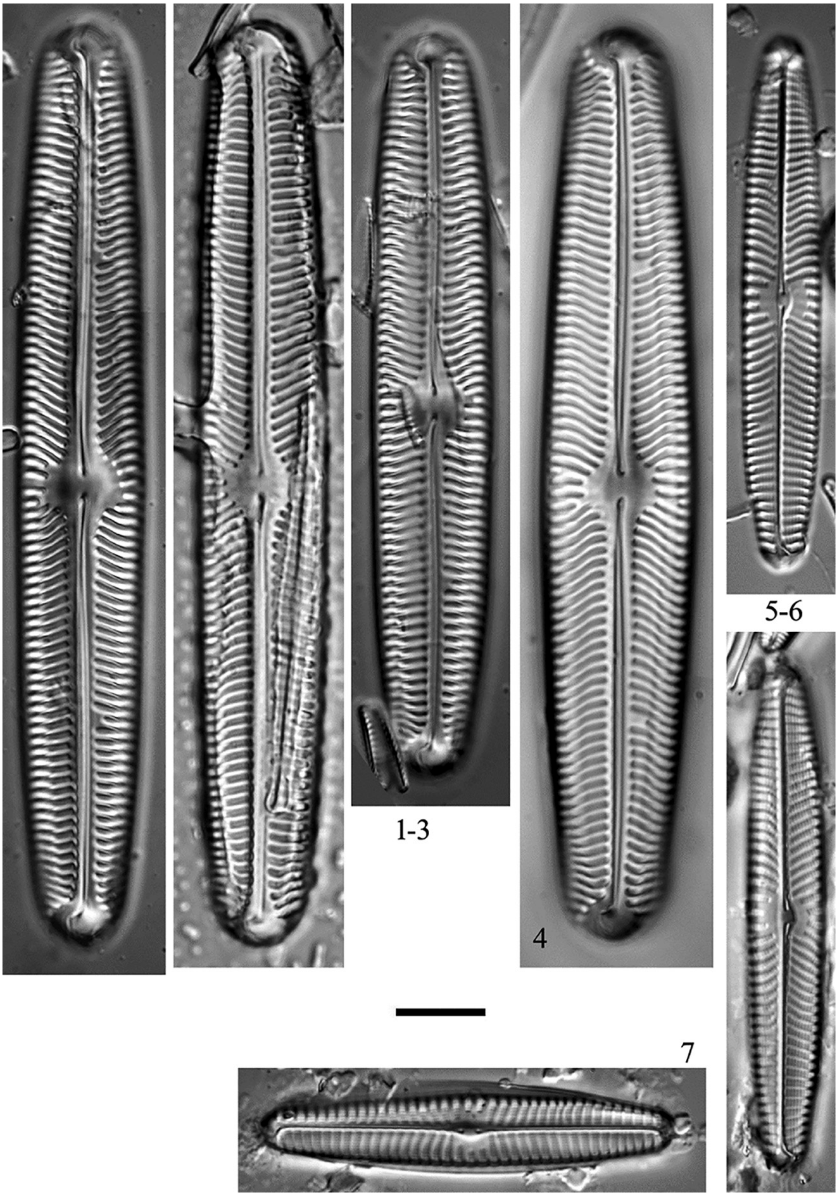

Plate 51 – *Navicula peroblonga* Metzeltin, Lange-Bertalot & Soninkhishig (1.–3.), *Navicula oblonga* (Kützing) Kützing (4.), *Navicula* sp. 1. (5.–7.).

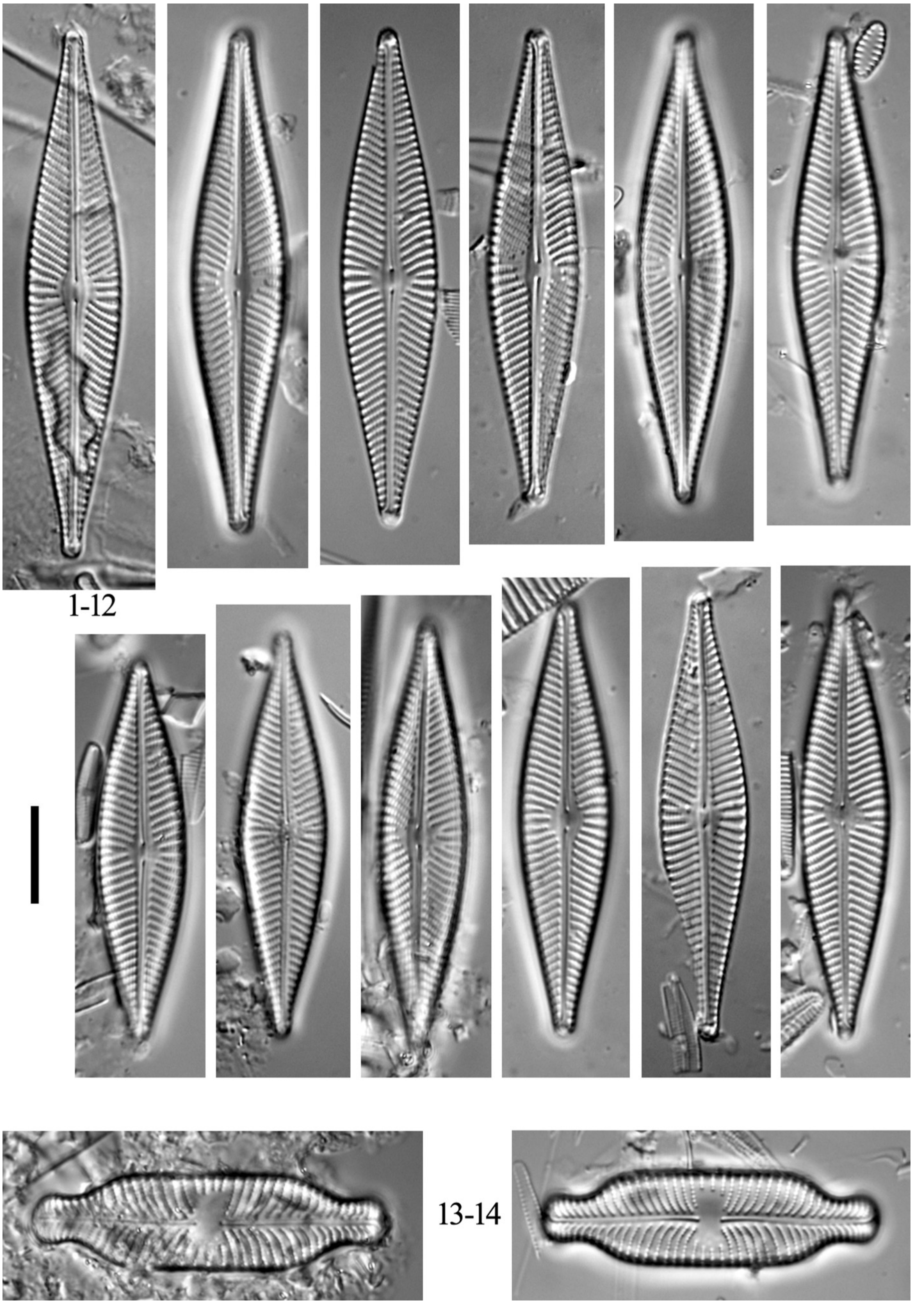

PLATE 52 – *Navicula oligotraphenta* Lange-Bertalot & Hofmann (1.–12.), *Placoneis abiskoensis* (Hustedt) Lange-Bertalot & Metzeltin (13., 14.).

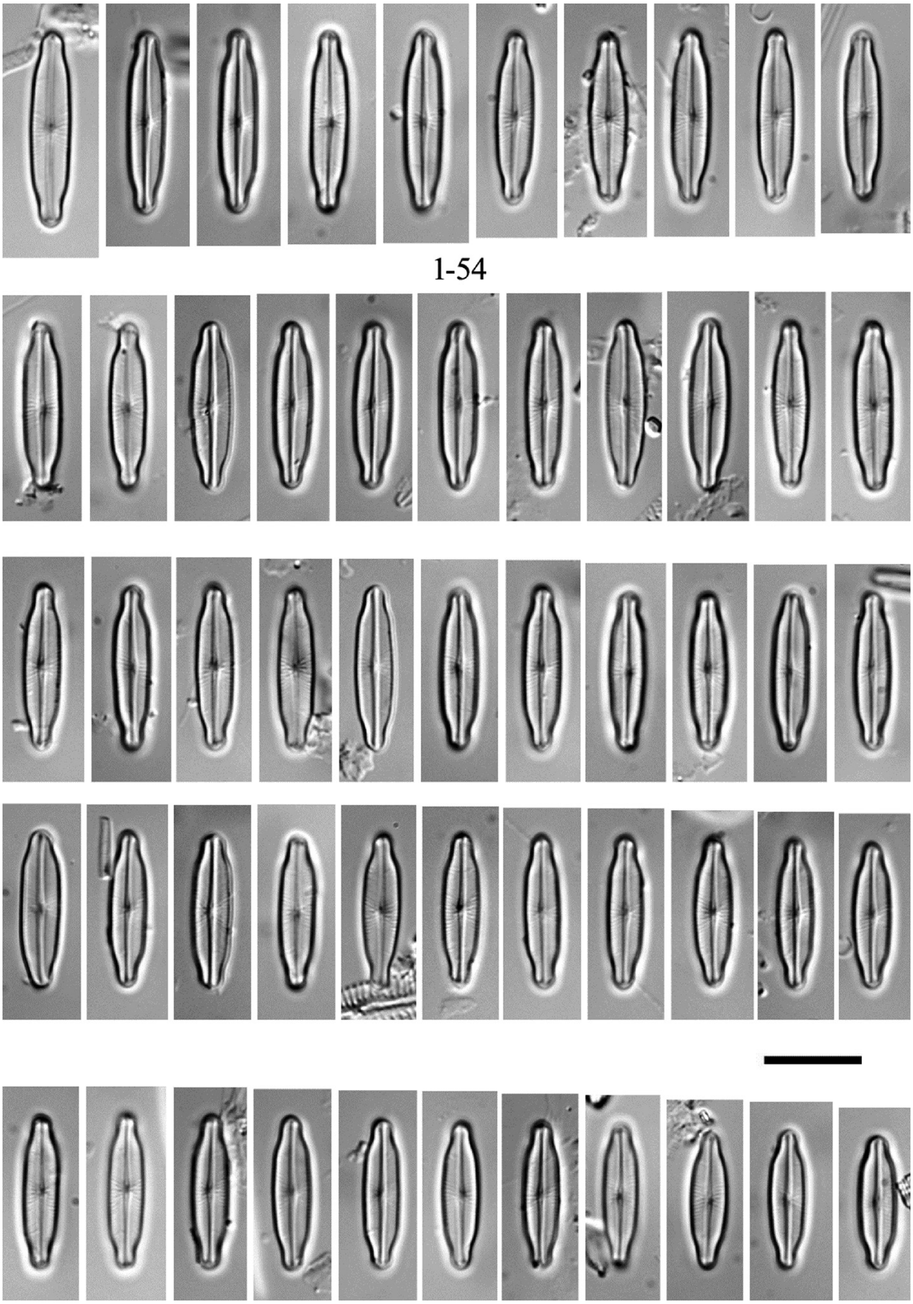

Plate 53 – *Adlafia bryophila* (J.B. Petersen) Lange-Bertalot (1.–54.).

PLATE 54. *Amphipleura pellucida* (Kützing) Kützing, *Adlafia* sp.1. nov., *Geissleria acceptata* (Hustedt) Lange-Bertalot & Metzeltin, *Luticola ventriconfusa* Lange-Bertalot, *Fallacia subhamulata* (Grunow) D.G. Mann, *Kobayasiella parasubtilissima* (H. Kobayasi & T. Nagumo) Lange-Bertalot

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Figs 1, 2. *Amphipleura pellucid*a (Kützing) Kützing

Valves lanceolate to linear-lanceolate, gradually tapering towards narrowly rounded apices. Valve length is 118–128 μm, valve width is 7.5–8.5 μm. Axial area is very narrow, linear. Central area is absent. Raphe branches are greatly shortened. A long median rib is present through most of the valve. At the raphe branches, two longitudinal ribs surround the raphe. At the distal raphe end, a porte-crayon structure of moderate size and shape is present. Striae are extremely fine and hardly visible, 45–50 in 10 μm. Well-organized longitudinal striae are also present but are not resolvable in the LM.

Amphipleura pellucida is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 3–34. *Adlafia* sp.1. nov.

Valves are linear and very narrow, with parallel or weakly convex or undulated margins. Valve ends are rostrate to sub-capitate. Valve length is 13–17 μm, valve width is 2.0–2.5 μm. Axial area is very narrow and slightly widens near the central area. Central area is indistinct, only slightly expanded and bordered by unequally shortened central striae. The raphe is straight and filiform with proximal raphe ends expanded into distinct central pore and bent to one side. Distal raphe ends are curved towards the opposite side of the valve. Striae strongly radiate in the middle, becoming strongly divergent towards apices, 35–40 in 10 μm. Areolae not recognizable with LM.

Adlafia sp. 1. looks similar with the respect to the valve shape to *A. bryophila*, but it is narrower. In the study area, it is common (especially in sample 33 – 2J), where is one of the dominant.

Fig. 35. *Geissleria acceptata* (Hustedt) Lange-Bertalot & Metzeltin

Fig. 36. *Luticola ventriconfusa* Lange-Bertalot

Figs 37–40. *Fallacia subhamulata* (Grunow) D.G. Mann

Figs 41, 42. *Kobayasiella parasubtilissima* (H. Kobayasi & T. Nagumo) Lange-Bertalot

Scale bar = 10 μm
LM 1500x

Figs 1–42. Jiuzhaigou National nature reserve, sample 33 – 2J, and various samples.

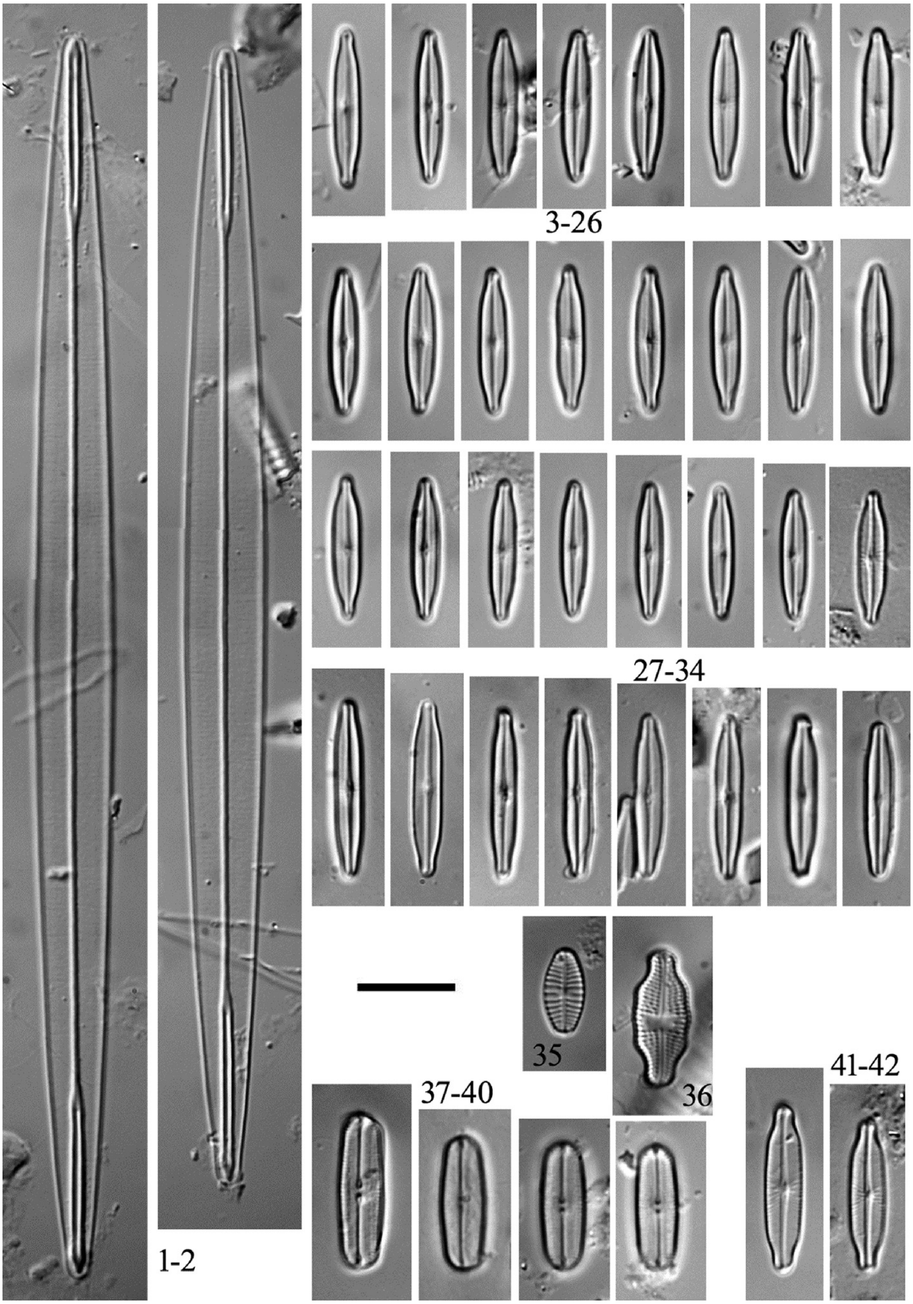

PLATE 54 – *Amphipleura pellucida* (Kützing) Kützing (1., 2.), *Adlafia* sp.1. nov. (3.–34.), *Geissleria acceptata* (Hustedt) Lange-Bertalot & Metzeltin (35.), *Luticola ventriconfusa* Lange-Bertalot (36.), *Fallacia subhamulata* (Grunow) D.G. Mann (37.–40.), *Kobayasiella parasubtilissima* (H. Kobayasi & T. Nagumo) Lange-Bertalot (41., 42.).

PLATE 55. *Sellaphora stroemii* (Hustedt) D.G. Mann, *Chamaepinnularia* sp. 1., *Chamaepinnularia* sp. 2., *Microcostatus naumanii* (Hustedt) Lange-Bertalot

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Figs 1–31. *Sellaphora stroemii* (Hustedt) D.G. Mann

Valves are linear with slightly convex margins and rounded broad ends. Valve length is 10–22 μm, valve width is 4.0–5.0 μm. The axial area is narrow, linear. Central area variable in shape and size, usually bow-tie–shaped to rectangular. Raphe filiform, straight, with the proximal raphe ends bent towards the primary side of the valve. The raphe sternum is flanked by parallel furrows, continuous or interrupted at the level of central area, often visible under LM as longitudinal lines. Striae radiate, 24–29 in 10 μm, becoming sparser and sometimes alternating irregularly, shorter and longer in the central area.

Sellaphora stroemii is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 32–39. *Chamaepinnularia* sp. 1.

Figs 40–46. *Chamaepinnularia* sp. 2.

Figs 47–50. *Microcostatus naumanii* (Hustedt) Lange-Bertalot

Valves are lanceolate with slightly protracted and broadly rounded apices. Valve length is 11–15 μm, valve width is 3.5–4.0 μm. The sternum and central nodule are prominent and distinctly thickened. The proximal raphe ends are also prominent, while the distal raphe ends are difficult to resolve in LM. Lyre-shaped depressions are present on both sides of the sternum. Striae are clearly visible with the LM, radiate throughout valve, 22–24 in 10 μm.

Microcostatus naumanii is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–50. Jiuzhaigou National nature reserve, sample 72 – 2H.

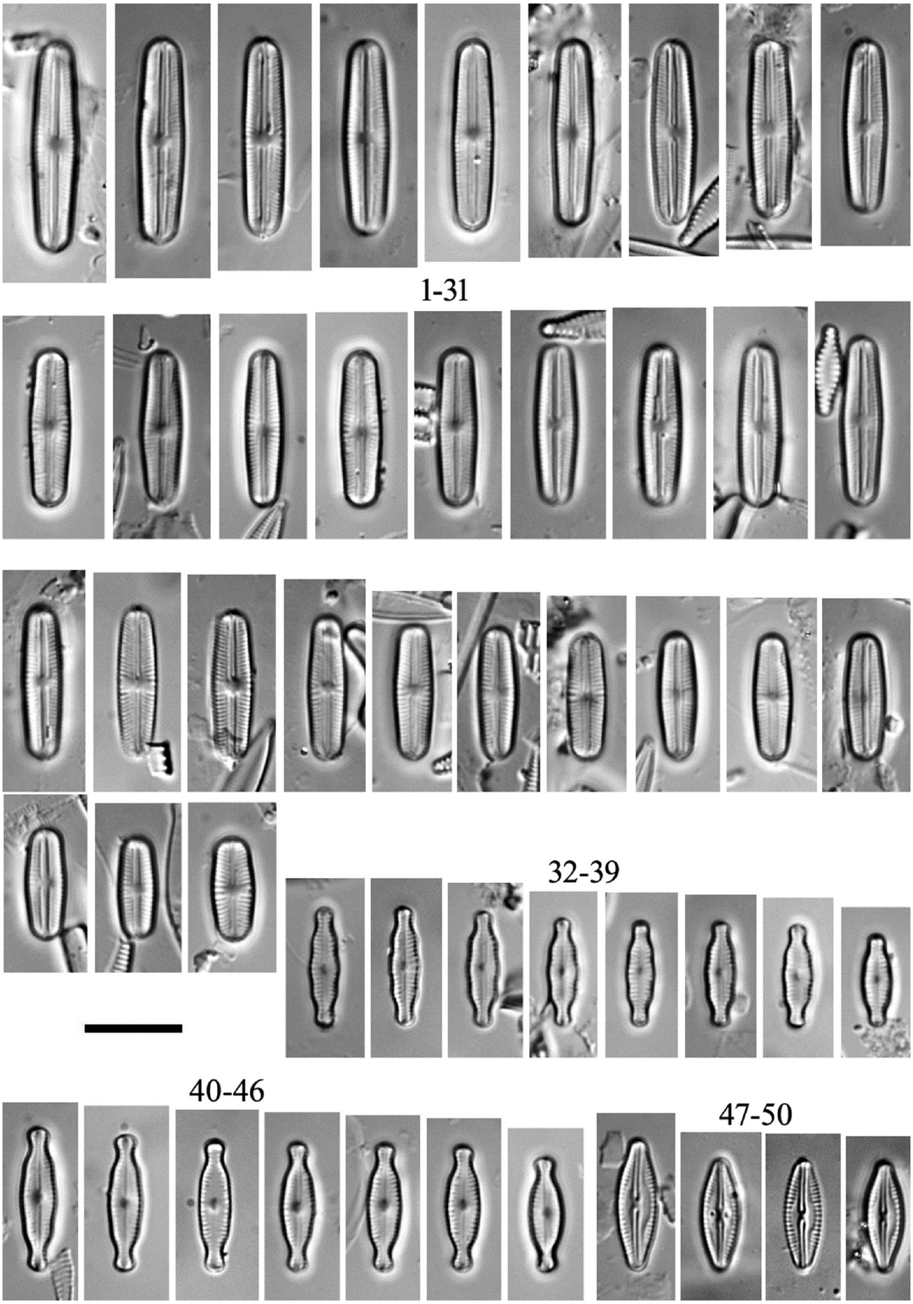

Plate 55 – *Sellaphora stroemii* (Hustedt) D.G. Mann (1.–31.), *Chamaepinnularia* sp. 1. (32.–39.), *Chamaepinnularia* sp. 2. (40.–46.), *Microcostatus naumanii* (Hustedt) Lange-Bertalot (47.–50.).

PLATE 56. *Sellaphora* sp. 1 nov.

Figs 1–27. *Sellaphora* sp. 1 nov.

Valves are broadly linear to linear-elliptic, with parallel or weakly convex margins. Valve apices are obtusely rounded. Valve length is 18–35 μm, valve width is 7.5–9.0 μm. The axial area is narrow and linear, bordered on each side by a moderately wide conopeum. The conopeum is continuous through the central area, where they expand laterally. The conopeum narrow to a point near the apices. The central area is moderately wide and rounded. The raphe is filiform and linear. Proximal raphe ends are deflected slightly to one side and expanded into small pores. Distal raphe ends are comma-shaped. Central striae are radiate and more distantly spaced. Striae are coarse and radiate, 18–2 in 10 μm.

Sellaphora sp. 1 has distinct morphological features and can be easily differentiated from other already-known species. Based on available literature it is supposed that it is new species. In the study area, it is frequently observed.

Recently a new species *Sellaphora constrictum* Kociolek & Q.-M. You (in You *et al.*, 2017) from Guizhou Province, Maolan Nature Reserve has been described.

Scale bar = 10 μm
LM 1500x

Figs 1.–27. Jiuzhaigou National nature reserve, sample Acc. No. 42.

PLATE 57. *Frustulia vulgaris* (Thwaites) De Toni, *Frustulia amosseana* Lange-Bertalot, *Berkella linearis* Ross & Sims

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Figs 1–6. *Frustulia vulgaris* (Thwaites) De Toni

Valves are linear-lanceolate to rhombic-lanceolate with subrostrate and rounded apices. Valve length is 49–56 μm, valve width is 9.5–10.5 μm. Axial area is narrow linear, slightly widened near the central area; not continuing to the valve apices but terminating near the valve/mantle margin some distance from the distal raphe ends. Central area is transapically elongated, elliptical. Raphe is slightly curved with y-shaped proximal and distal ends. Striae are finely punctate, radiate at the valve centre, becoming slightly radiate or almost parallel, finally convergent and circumradiating the valve ends, ca. 30 in 10 μm. Internally, longitudinal ribs are parallel to the raphe, clearly visible with LM as dark lines near the raphe. The longitudinal ribs fuse with the helictoglossae to form a porte- crayon structure.

Frustulia vulgaris is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 7–10. *Frustulia amosseana* Lange-Bertalot

Valves are linear to linear-lanceolate, slightly convex to parallel valve margins. Valve apices are subcapitate to capitate and broadly rounded. Valve length is 46–50 μm, valve width is 7.0–8.5 μm. Axial area narrow, linear. The central area is linear and elongated. Raphe branches are distinctly curved and bordered by longitudinal ribs that do not extend into the central area. Proximal ends of the longitudinal ribs are blunt. Internally, longitudinal ribs are parallel to the raphe, clearly visible with LM as dark lines near the raphe. The longitudinal ribs fuse with the helictoglossae to form a porte-crayon structure. Striae are parallel at the valve centre, slightly convergent towards the ends, and radiate around the apices, 30–34 in 10 μm.

Frustulia amosseana is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 11–19. *Berkella linearis* Ross & Sims

Scale bar = 10 μm
LM 1500x

Figs 1–19. Jiuzhaigou National nature reserve, sample Acc. No. 16.

PLATE 58. *Berkella linearis* Ross & Sims

Figs 1–19. *Berkella linearis* Ross & Sims

Valves are linear with slightly undulated or slightly concave margins. Valve apices are rostrate to subrostrate and narrowly rounded. Valve length is 28–49 μm, valve width is 6.0–7.0 μm. The axial area narrow, linear. The central area is linear and elongated. Raphe branches are slightly curved and bordered by longitudinal ribs that do not extend into the central area. Proximal ends of the longitudinal ribs are blunt. Internally, longitudinal ribs are parallel to the raphe, clearly visible with LM as dark lines near the raphe. The longitudinal ribs fuse with the helictoglossae to form a porte-crayon structure. Striae are parallel at the valve centre, slightly convergent towards the ends, and radiate around the apices, 32–36 in 10 μm.

Berkella linearis is forgotten taxon since it was considered as conspecific with *Frustulia (Berkella) amosseana* (Lange-Bertalot, 2001), but the latter species can be easily differentiated by the shape of the valve apices and valve width. It is a widely spread (cosmopolitan) species, and was frequently observed in the samples from Jiuzhaigou National nature reserve.

Berkella linearis is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–19. Jiuzhaigou National nature reserve, sample Acc. No. 4.

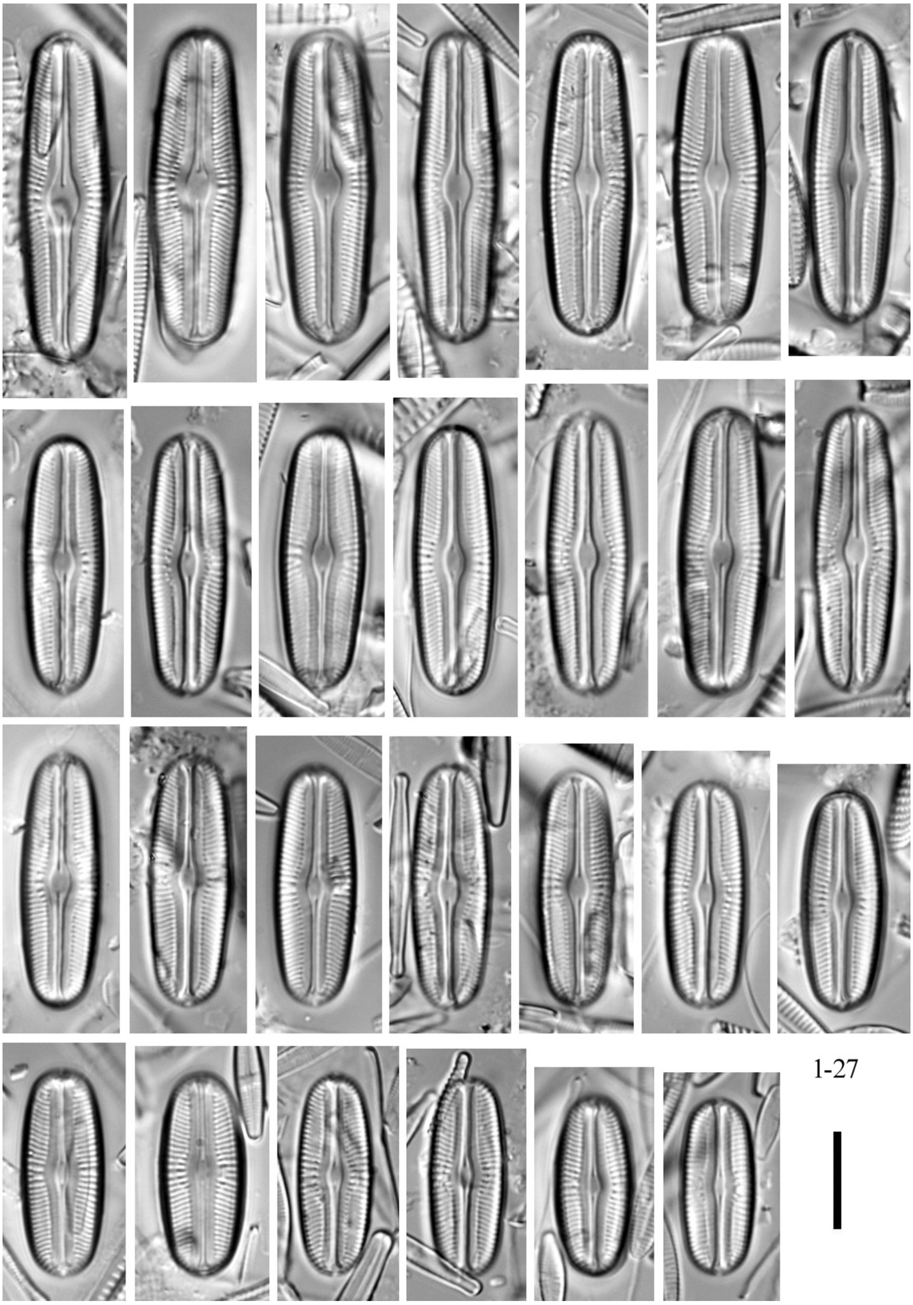

Plate 56 – *Sellaphora* sp. 1 nov. (1.–27.).

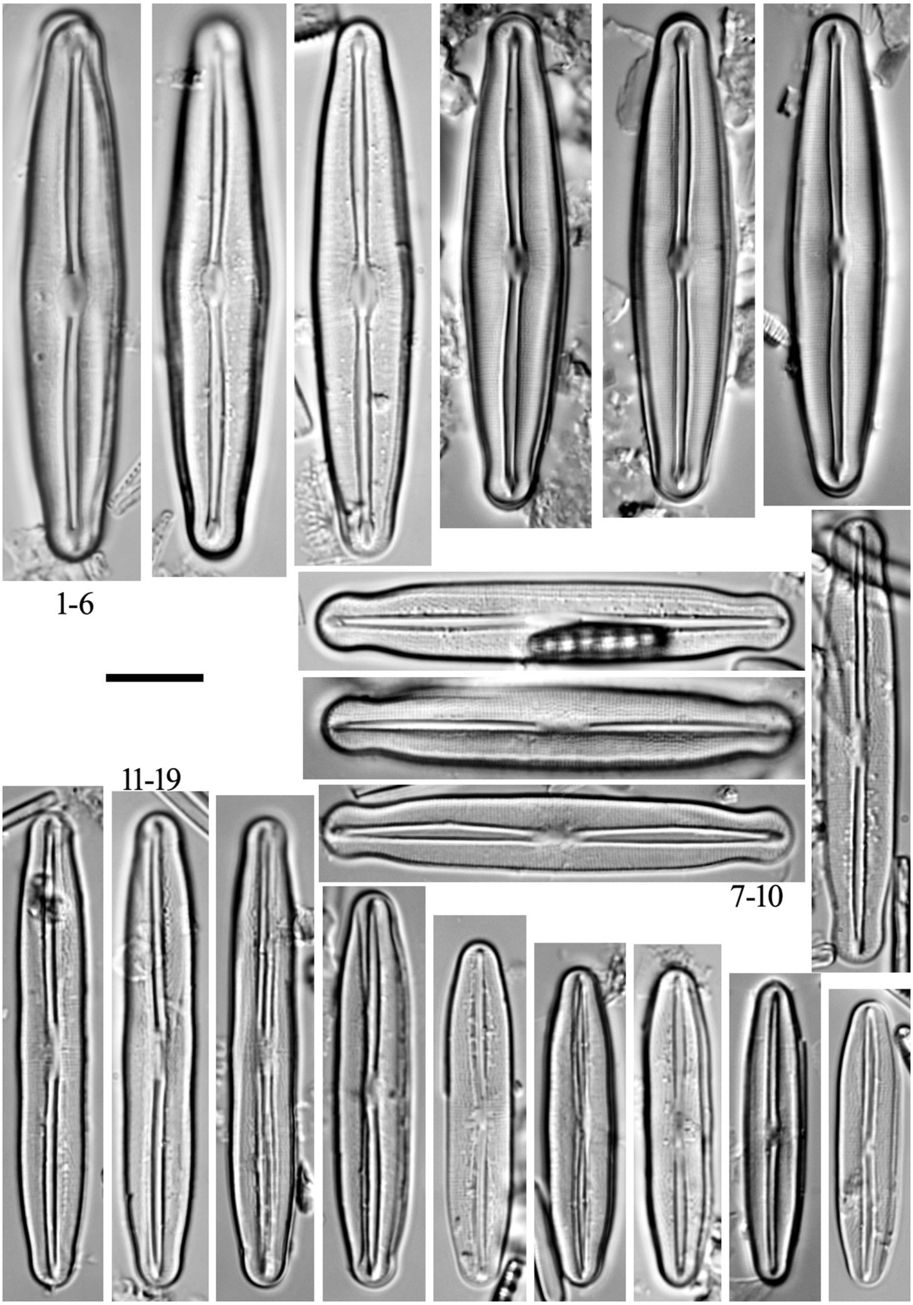

PLATE 57 – *Frustulia vulgaris* (Thwaites) De Toni (1.–6.), *Frustulia amosseana* Lange-Bertalot (7.–10.), *Berkella linearis* Ross & Sims (11.–19.).

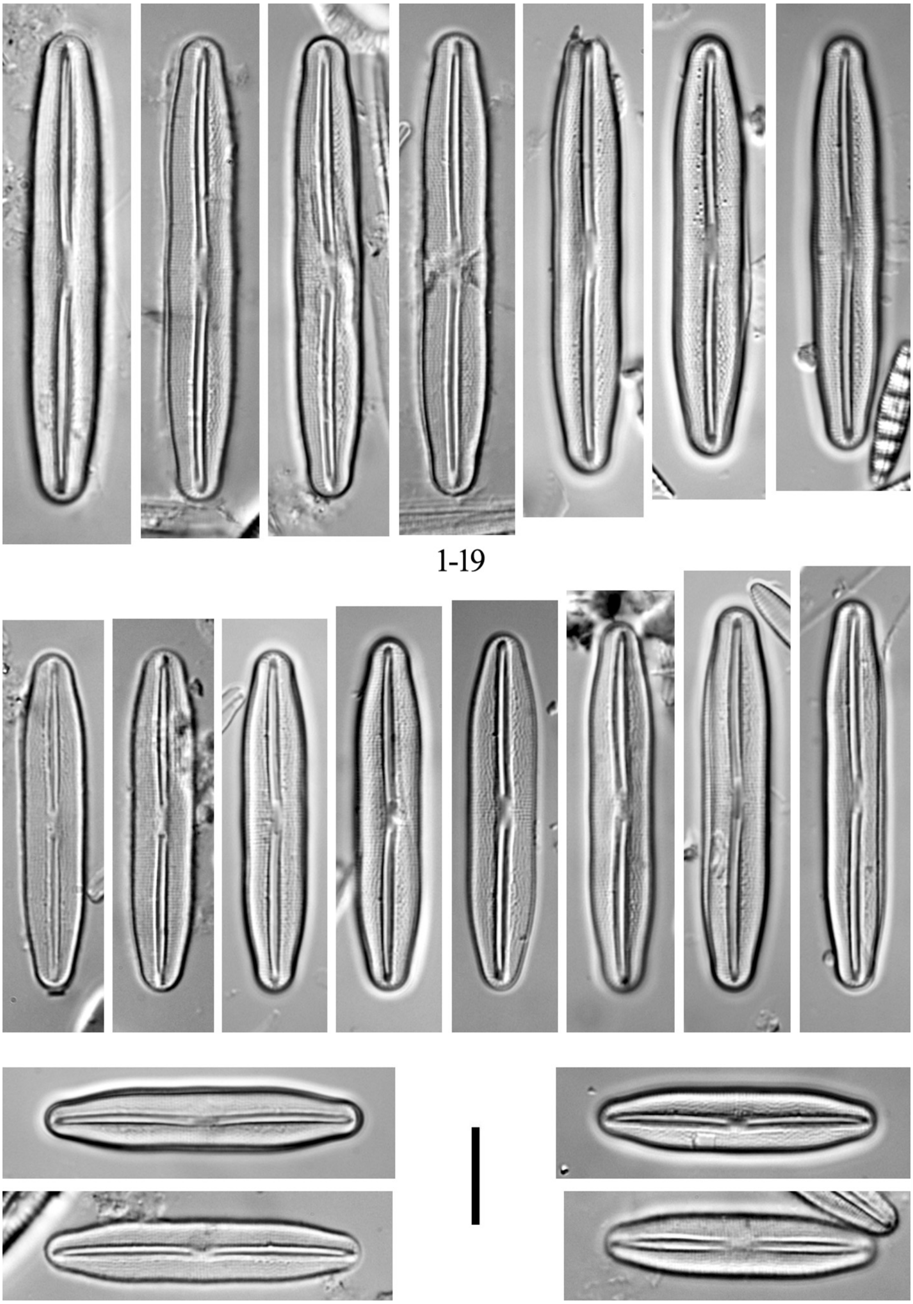

Plate 58 – *Berkella linearis* Ross & Sims (1.–19.).

PLATE 59. *Stauroneis conspicua* Metzeltin & Lange-Bertalot, Stauroneis gracilis Ehrenberg, *Aneumastus tusculus* (Ehrenberg) D.G. Mann & A.J. Stickle, *Neidium distinctepunctatum* Hustedt, *Neidium bisulcatum* var. *subampliatum* Krammer, *Neidium bisulcatum* (Lagerstedt) Cleve, *Neidiomorpha binodiformis* (Krammer) Cantonati, Lange-Bertalot & N. Angeli, *Stauroneis separanda* Lange-Bertalot & Werum

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Fig. 1. *Stauroneis conspicua* Metzeltin & Lange-Bertalot

Fig. 2. *Stauroneis gracilis* Ehrenberg

Fig. 3. *Aneumastus tusculus* (Ehrenberg) D.G. Mann & A.J. Stickle

Valves are broadly linear-elliptic with abruptly protracted, long subcapitate to capitate apices. Valve length is 45–60 μm, valve width is 16.0–20.0 μm. The axial area is narrow, linear. The central area is stauroid, bordered by 4–5 irregularly shortened striae on each side. The raphe is lateral and sinuous, distinguished by a pronounced wave in the area of the Voigt faults. Proximal raphe ends are expanded into central pores. Striae weakly radiate near the central area, becoming strongly radiate near the poles. Striae composed of complex transapically elongated areolae near the valve center. Striae are uniseriate near the raphe, becoming biseriate towards valve margin. Areolae in the central part of the valve number 8–10 in 10 μm.

Fig. 4. *Neidium distinctepunctatum* Hustedt

Valves are lanceolate with slightly protracted and broadly rounded apices. A longitudinal line is evident along each margin. The axial area is straight, linear, becoming slightly wider near the central area. The central area is narrow, oblique bordered by short striae along the valve margins. The raphe is lateral, becoming filiform at the proximal ends, which are hooked sharply in opposite directions. Striae are coarse, and oriented slightly diagonally across the valve face.

Neidium distinctepunctatum is considered a rare species, and only one valve was observed in the samples from Jiuzhaigou National nature reserve.

Recently a new Neidium species *Neidium convolutum* Y. Liu & Kociolek (in Liu *et al.*, 2020a) was described Guangxi Zhuang Autonomous Region: Shiwan Mts. National Forest Park.

Fig. 5. *Neidium bisulcatum* var. *subampliatum* Krammer

Figs 6, 7. *Neidium bisulcatum* (Lagerstedt) Cleve

Figs 8, 9. *Neidiomorpha binodiformis* (Krammer) Cantonati, Lange-Bertalot & N. Angeli

Figs 10, 11. *Stauroneis separanda* Lange-Bertalot & Werum

Scale bar = 10 μm
LM 1500x

Figs 1–11. Jiuzhaigou National nature reserve, sample Acc. No. 4.

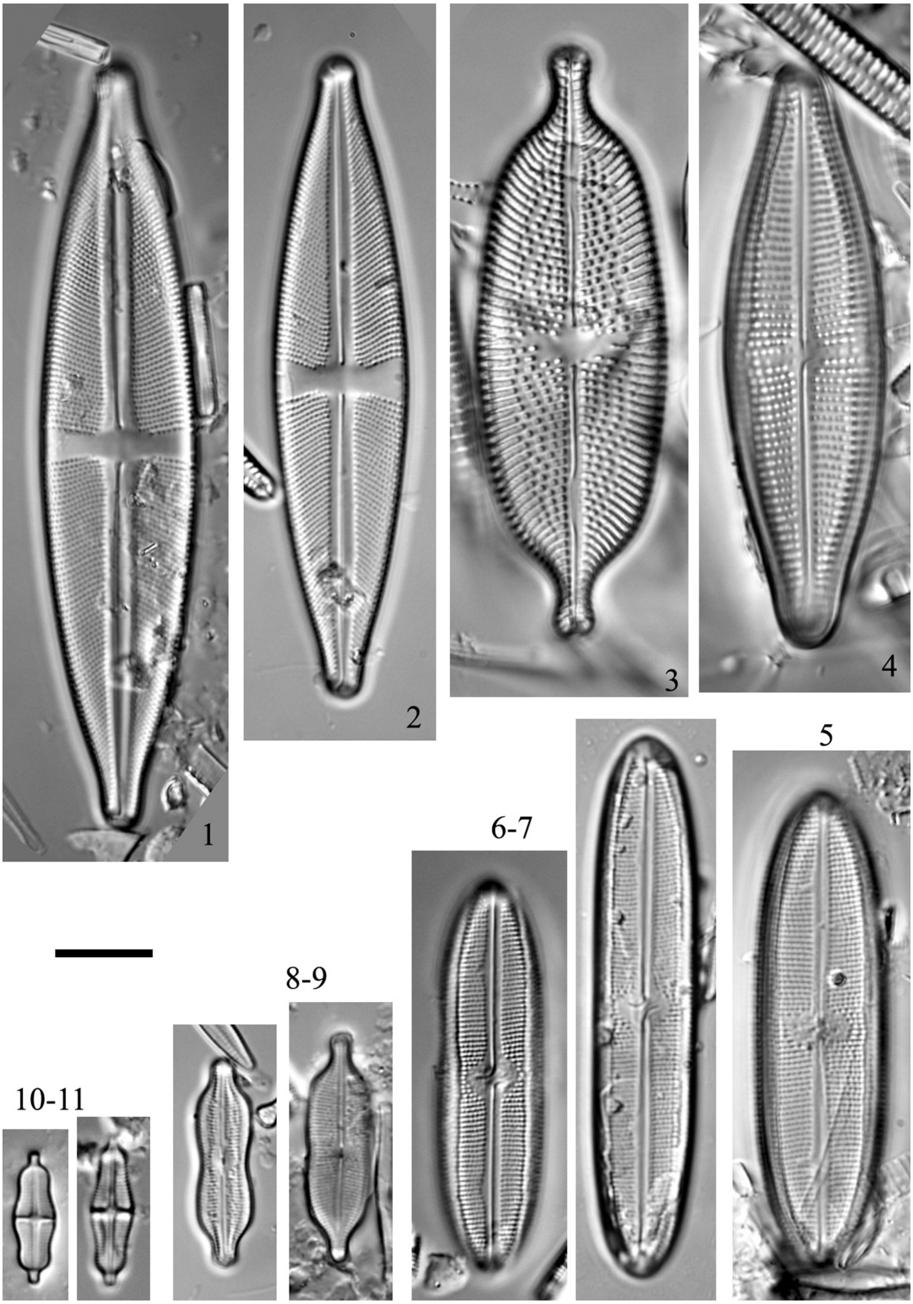

Plate 59 – *Stauroneis conspicua* Metzeltin & Lange-Bertalot (1.), *Stauroneis gracilis* Ehrenberg (2.), *Aneumastus tusculus* (Ehrenberg) D.G. Mann & A.J. Stickle (3.), *Neidium distinctepunctatum* Hustedt (4.), *Neidium bisulcatum* var. *subampliatum* Krammer (5.), *Neidium bisulcatum* (Lagerstedt) Cleve (6., 7.), *Neidiomorpha binodiformis* (Krammer) Cantonati, Lange-Bertalot & N. Angeli (8., 9.), *Stauroneis separanda* Lange-Bertalot & Werum (10., 11.).

PLATE 60. *Brachysira* sp. 1. nov.

Figs 1–45. *Brachysira* sp. 1. nov.

Valves are broadly elliptic-lanceolate to asymmetric, clavate with capitate apices. Upper valve end (headpole) might be rostrate, while lower end (footpole) might be capitate or both ends are capitate. Valve length is 14–27 μm, valve width is 5.0–5.5 μm. The axial area is narrow. The central area is small, elliptic, or not well-defined. The raphe is filiform and straight. Proximal raphe ends are weakly expanded. Distal raphe ends are indistinct in LM. Striae are radiate and uniseriate, 34–36 in 10 μm. Areolae in the striae are irregularly spaced, creating a pattern of undulating longitudinal lines.

Scale bar = 10 μm
LM 1500x

Figs 1–45. Jiuzhaigou National nature reserve, sample Acc. No. 72 – 2H.

PLATE 61. *Brachysira vitrea* (Grunow) R. Ross, *Brachysira microcephala* (Grunow) Compère

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Figs 1–16. *Brachysira vitrea* (Grunow) R. Ross

Valves are broadly elliptic-lanceolate to asymmetric, clavate with capitate apices. Upper valve end (headpole) might be rostrate, while lower end (footpole) might be capitate or both ends are capitate. Valve length is 24–35 μm, valve width is 6.5–7.5 μm. The axial area is narrow. The central area is small, elliptic, or not well-defined. The raphe is filiform and straight. Proximal raphe ends are weakly expanded. Distal raphe ends are indistinct in LM. Striae are radiate and uniseriate, 32–35 in 10 μm. Areolae in the striae are irregularly spaced, creating a pattern of undulating longitudinal lines.

Brachysira vitrea is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 17–33. *Brachysira microcephala* (Grunow) Compère

Valves are narrowly lanceolate to rhombic-lanceolate with narrowly rounded to subcapitate apices. Valve length is 22–31 μm, valve width is 5.0–5.5 μm. The axial area is narrow. The central area is small, elliptic or not well-defined. The raphe is filiform and straight. Proximal raphe ends are weakly expanded. Distal raphe ends are indistinct in LM. Striae are radiate and uniseriate, 32–36 in 10 μm. Areolae in the striae are irregularly spaced, creating a pattern of undulating longitudinal lines.

Brachysira microcephala is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–16. Jiuzhaigou National nature reserve, sample Acc. No. 11.
Figs 17–33. Jiuzhaigou National nature reserve, sample Acc. No. 73 – 2eH.

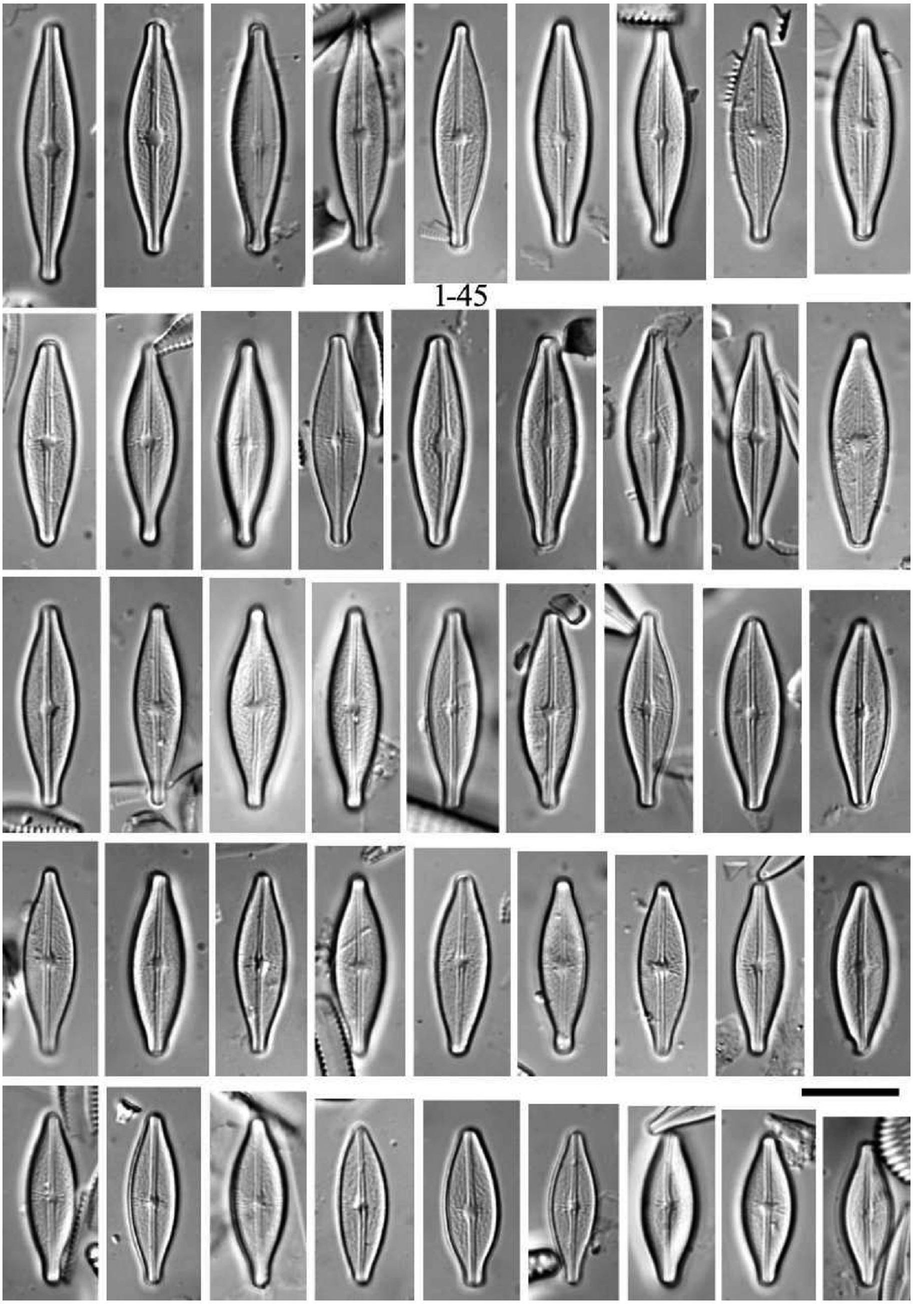

Plate 60 – *Brachysira* sp. 1. nov. (1.–45.).

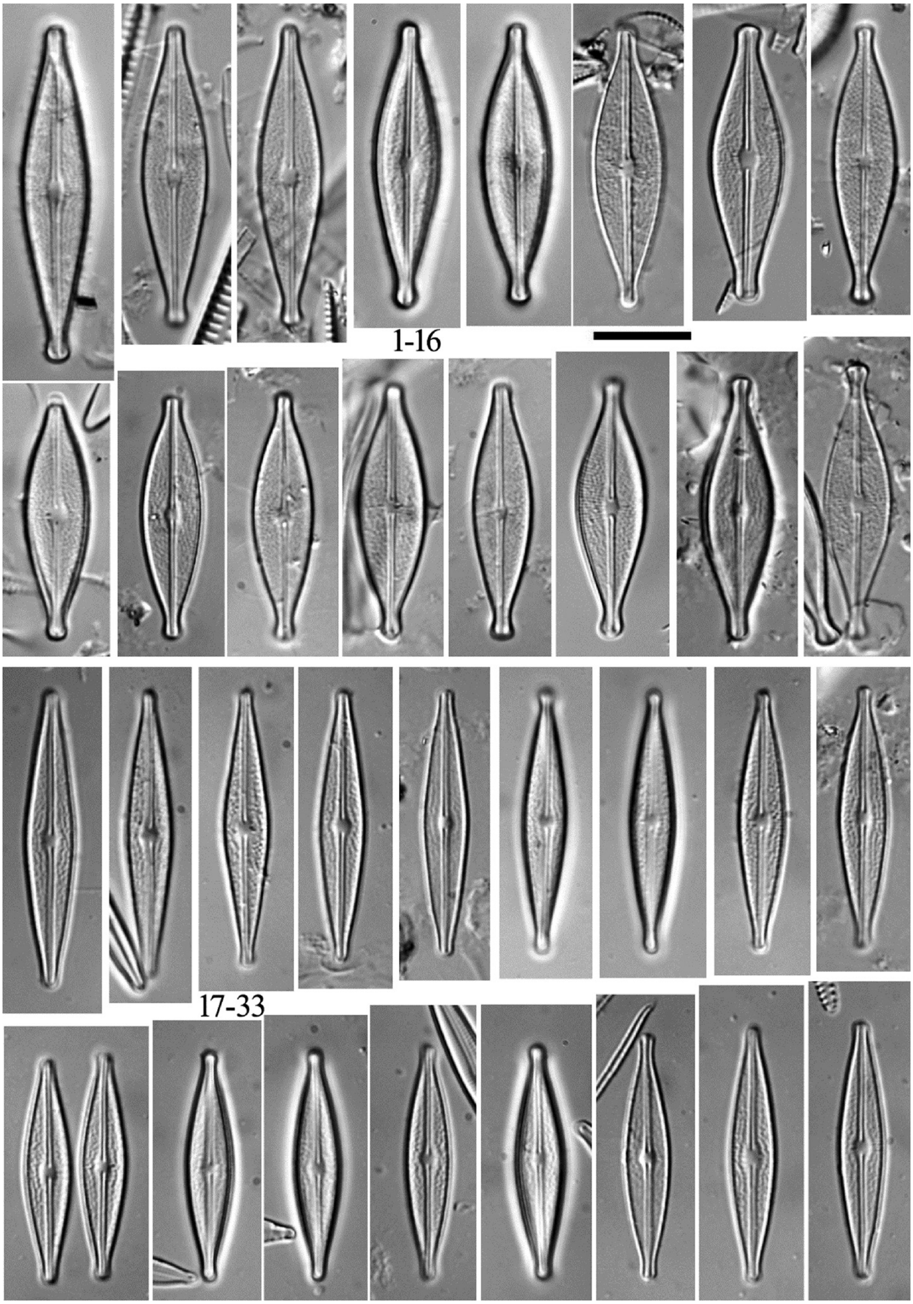

Plate 61 – *Brachysira vitrea* (Grunow) R. Ross (1.–16.), *Brachysira microcephala* (Grunow) Compère (17.–33.).

PLATE 62. *Brachysira neoexilis* Lange-Bertalot, *Brachysira* sp. 2. nov., *Brachysira* sp. 3. nov.

Figs 1–8. *Brachysira neoexilis* Lange-Bertalot

Valves are narrow lanceolate with broadly capitated apices. Valve length is 22–27 μm, valve width is 3.0–4.5 μm. The axial area is narrow. The central area is small, elliptic, or not well-defined. The raphe is filiform and straight. Proximal raphe ends are weakly expanded. Distal raphe ends are indistinct in LM. Striae are radiate and uniseriate, 30–35 in 10 μm. Areolae in the striae are irregularly spaced, creating a pattern of undulating longitudinal lines.

Brachysira neoexilis is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve

Figs 9–18. *Brachysira* sp. 2. nov.

Figs 19–34. *Brachysira* sp. 3. nov.

Valves are rhombic-elliptical with slightly rostrate to subcapitate apices. Valve length is 18–23 μm, valve width is 4.5–6 μm. The axial area is narrow. The central area is small, elliptic, or not well-defined. The raphe is filiform and straight. Proximal raphe ends are weakly expanded. Distal raphe ends are indistinct in LM. Striae are radiate and uniseriate, 32–35 in 10 μm. Areolae in the striae are irregularly spaced, creating a pattern of undulating longitudinal lines. Areolae in the striae are irregularly spaced, creating a pattern of undulating longitudinal lines.

Based on available literature *Brachysira* sp. 3 is unknown taxon so far observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–34. Jiuzhaigou National nature reserve, sample Acc. No. 73 – 2eH.

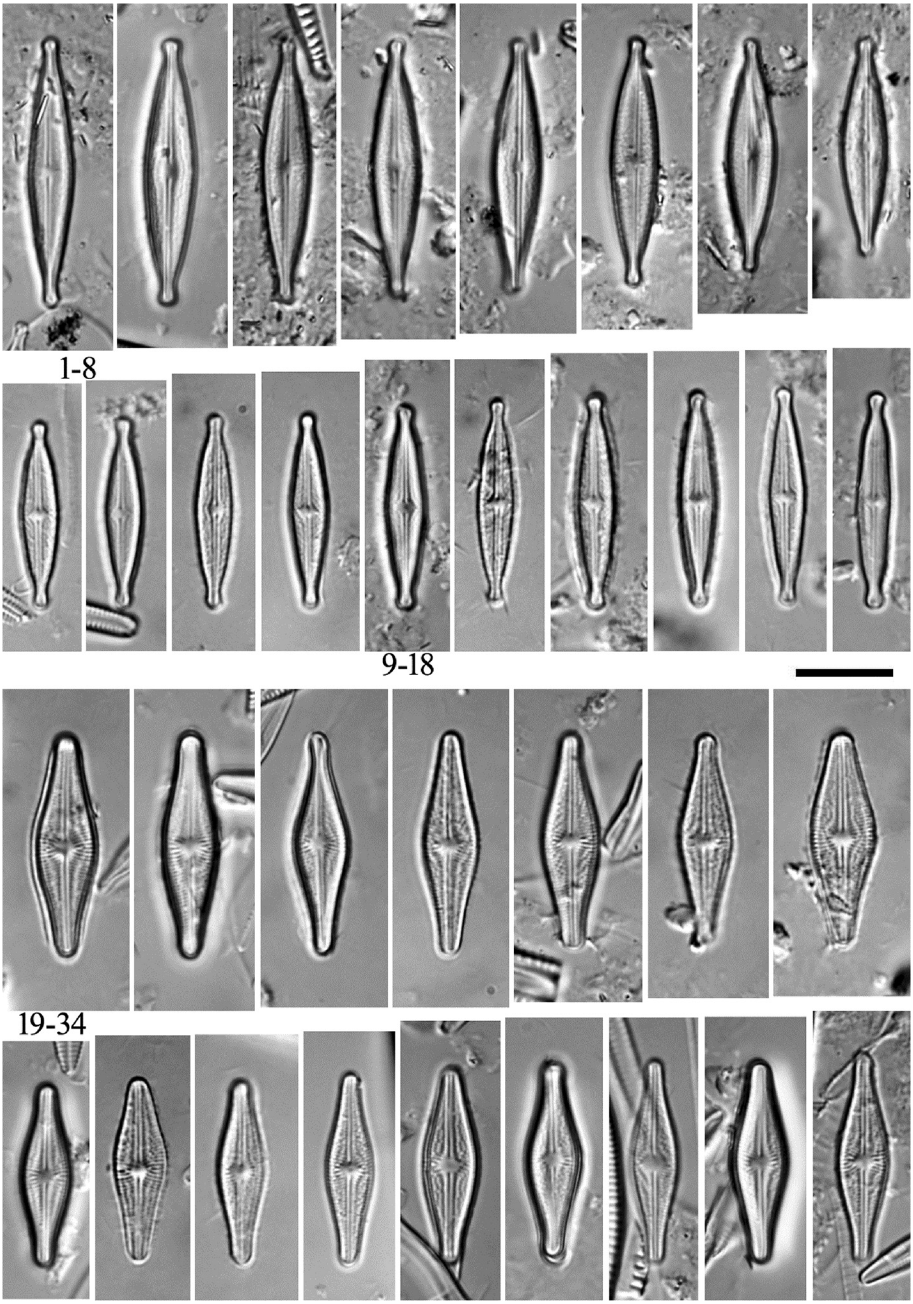

Plate 62 – *Brachysira neoexilis* Lange-Bertalot (1.–8.), *Brachysira* sp. 2. nov. (9.–18.), *Brachysira* sp. 3. nov. (19.–34.).

PLATE 63. *Diploneis* sp. 1. nov.

Figs 1–26. *Diploneis* sp. 1. nov.

The valves are liner-elliptical with almost parallel to slightly convex margins and bluntly rounded apices. Valve length is 18–40 μm, valve width is 9.0–11.0 μm. The axial area is narrow, linear with weakly expanded central area. The longitudinal canal is linear and slightly expanded in the middle with a single row of cribrate areolae. The raphe is linear with slightly expanded drop-like proximal ends that are bent to the same side of the valve. The distal raphe branches are bent to the same side of the valve as the proximal ends. The striae are parallel to slightly radiate, 13–16 in 10 μm, with one row of small round areolae.

The genus Diploneis was recently revised by Lange-Bertalot *et al.* (2020) and Jovanovska and Levkov (2020) and species with such morphological and numerical features have not been observed. It is previously recorded in P.R. China as *D. ovalis* var. *oblongella* (Nägeli) Cleve. It is supposed that is widely distributed in P.R. China but was confused with other Diploneis species.

Scale bar = 10 μm
LM 1500x

Figs 1–26. Jiuzhaigou National nature reserve, sample Acc. No. 42.

PLATE 64. *Diploneis mollenhaueri* Lange-Bertalot & Fuhrmann, *Diploneis fontanella* Lange-Bertalot, *Diploneis calcicolafrequens* Lange-Bertalot & Fuhrmann, *Diploneis separanda* Lange-Bertalot

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Figs 1–5. *Diploneis mollenhaueri* Lange-Bertalot & Fuhrmann

The valves are linear-elliptical with bluntly rounded ends. The length of the valve is 32–47 μm, and the width of the valve is 14.0–16.0 μm. The axial area is linear to lanceolate, expanding towards the large and round central area. The longitudinal canal is linear to lanceolate, composed of two rows of areolae throughout the whole length. The raphe is linear with proximal ends positioned within a deep depression. The distal raphe ends are bent at a 45–900 angle to the same side of the valve as the proximal ends. The striae are radiate, 11–13 in 10 μm, with one row of round areolae, 9–15 in 10 μm, covered with cribra.

Diploneis mollenhaueri is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 6–11. *Diploneis fontanella* Lange-Bertalot
Fig. 12. *Diploneis calcicolafrequens* Lange-Bertalot & Fuhrmann
Figs 13–29. *Diploneis separanda* Lange-Bertalot

The valves are elliptical-lanceolate with bluntly rounded ends. Valve length is 11–23 μm; and valve width is 5.5–7.0 μm. The axial area is linear to lanceolate with slightly expanded central area (almost indistinct). The canal is linear to lanceolate, expanded in the middle with one, and in parts, two rows of areolae. The external openings of the canal are covered with cribra morphologically almost identical to those of the striae. The raphe is linear with simple proximal ends bent to the same side of the valve and positioned within a very shallow depression. The distal raphe ends are weakly bent into drop-like terminal fissures deflected to the same side of the valve as the proximal ends. The striae are radiate, 18–24 in 10 μm, composed of round areolae, 15–20 in 10 μm. The striae are uniseriate, becoming biseriate towards the valve margin.

Diploneis separanda is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–29. Jiuzhaigou National nature reserve, various samples.

PLATE 65. *Diploneis praetermissa* Lange-Bertalot & Furhmann, *Diploneis oculata* (Brébisson) A. Cleve, *Caloneis fontinalis* (Grunow) Lange-Bertalot & E. Reichardt, *Caloneis lancettula* (E. Schulz) Lange-Bertalot & A. Witkowski

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Figs 1–15. *Diploneis praetermissa* Lange-Bertalot & Furhmann

The valves are elliptical-lanceolate to elliptic with bluntly rounded ends. The length of the valve is 13–27 μm; and the width of the valve is 6.5–8.0 μm. The axial area is linear to lanceolate with slightly expanded transapically elongated central area. The longitudinal canal is narrow, linear and slightly expanded in the middle with indistinguishable number of areolae under LM. The raphe is linear with slightly expanded proximal ends. The striae are parallel in the middle of the valve, becoming radiate towards the valve apices, 15–22 in 10 μm, with indistinguishable number of areolae under LM.

Diploneis praetermissa is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 16–29. *Diploneis oculata* (Brébisson) A. Cleve

The valves are linear-elliptical with almost parallel margins and narrowly rounded to rounded apices. The length of the valve is 12–19 μm; and the width of the valve is 5.5–6.5 μm. The axial area is narrow, linear with small quadrate to slightly rectangular central area. The longitudinal canal is narrow, linear, and slightly widened in the central area and the valve apices. The canal is composed of single row of areolae externally occluded by C-shaped volae. The raphe is linear with slightly expanded drop-like proximal ends and bent to the same side of the valve. The distal raphe fissures are linear, short, and terminate at a short distance from the valve face-mantle edge. The striae are parallel to slightly radiate, 22–25 in 10 μm, occluded by volae that occupy less than half of the alveoli.

Diploneis oculata is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Fig. 30–32. *Caloneis fontinalis* (Grunow) Lange-Bertalot & E. Reichardt
Figs 33–38. *Caloneis lancettula* (E. Schulz) Lange-Bertalot & A. Witkowski

Scale bar = 10 μm
LM 1500x

Figs 1–38. Jiuzhaigou National nature reserve, various samples.

PLATE 66. *Caloneis alpestris* (Grunow) Cleve

Figs 1–26. *Caloneis alpestris* (Grunow) Cleve

Valves are linear to linear-lanceolate with slightly convex to almost parallel mid-valve margins and broadly rounded apices. Valve length 40–65 μm, valve width 9.0–10.5 μm. Axial area narrow, lanceolate, tapering towards valve apices. Central area moderately narrow, round. Lunate markings (maculae) are present in the central area. Raphe weakly lateral, becoming filiform towards the ends. Central pores large unilaterally deflected towards the primary valve side. Striae parallel in mid-valve, becoming radiate towards apices, 18–21 in 10 μm. Longitudinal bands visible in LM, located near valve margins.

Caloneis alpestis is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–26. Jiuzhaigou National nature reserve, sample Acc. No. 67 – 1Ah.

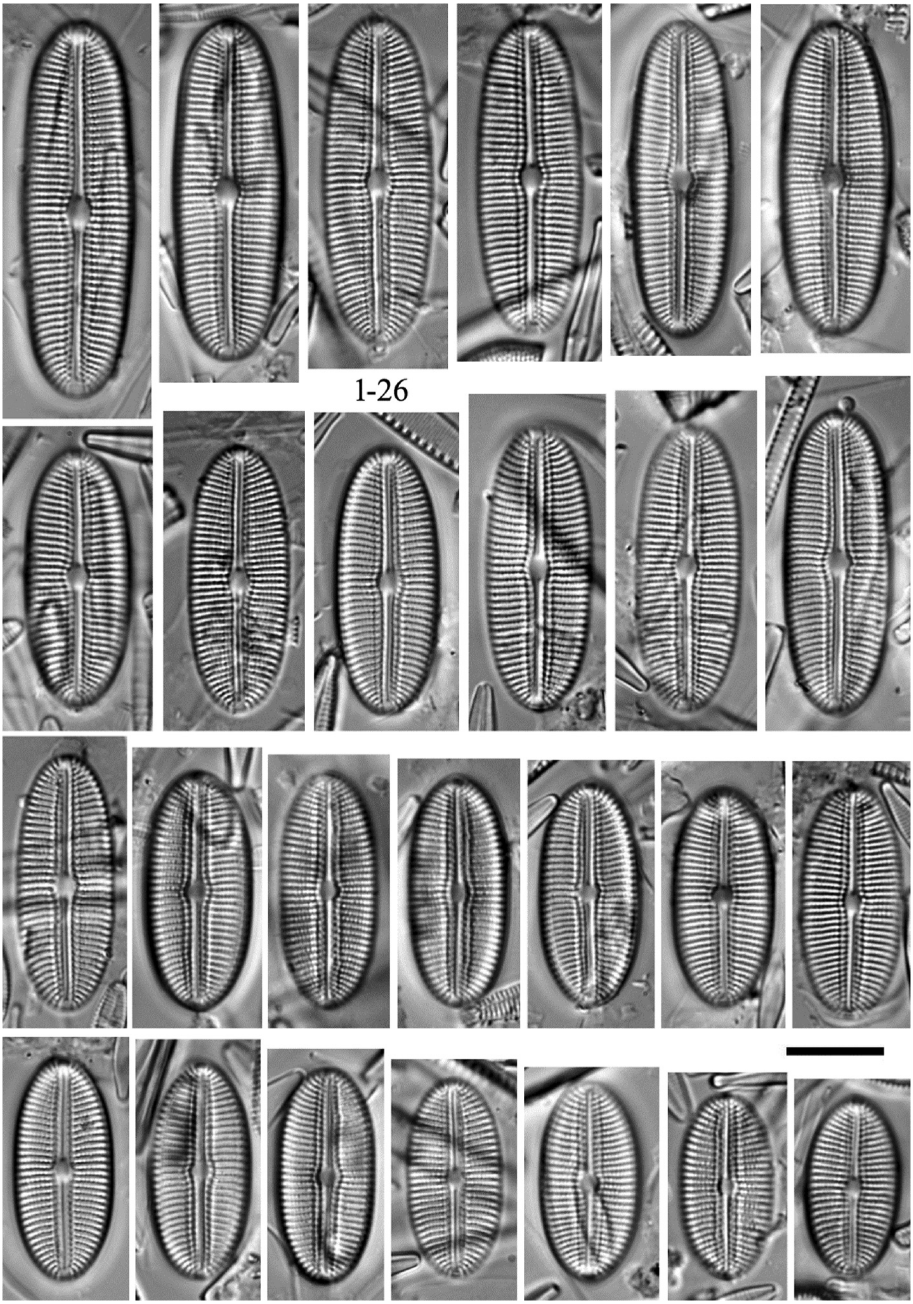

Plate 63 – *Diploneis* sp. 1. nov. (1.–26.).

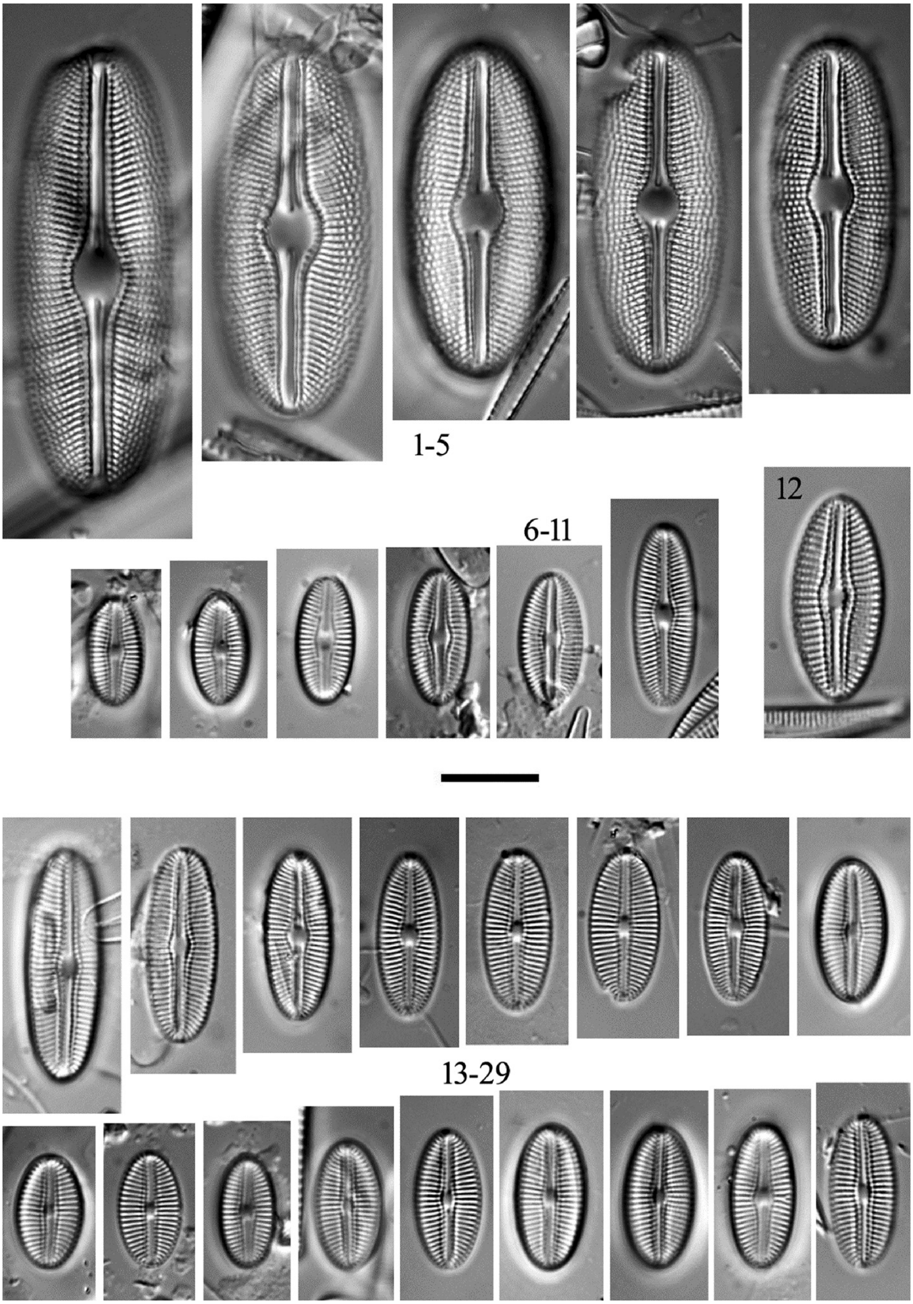

Plate 64 – *Diploneis mollenhaueri* Lange-Bertalot & Fuhrmann (1.–5.), *Diploneis fontanella* Lange-Bertalot (6.–11.), *Diploneis calcicolafrequens* Lange-Bertalot & Fuhrmann (12.), *Diploneis separanda* Lange-Bertalot (13.–29.).

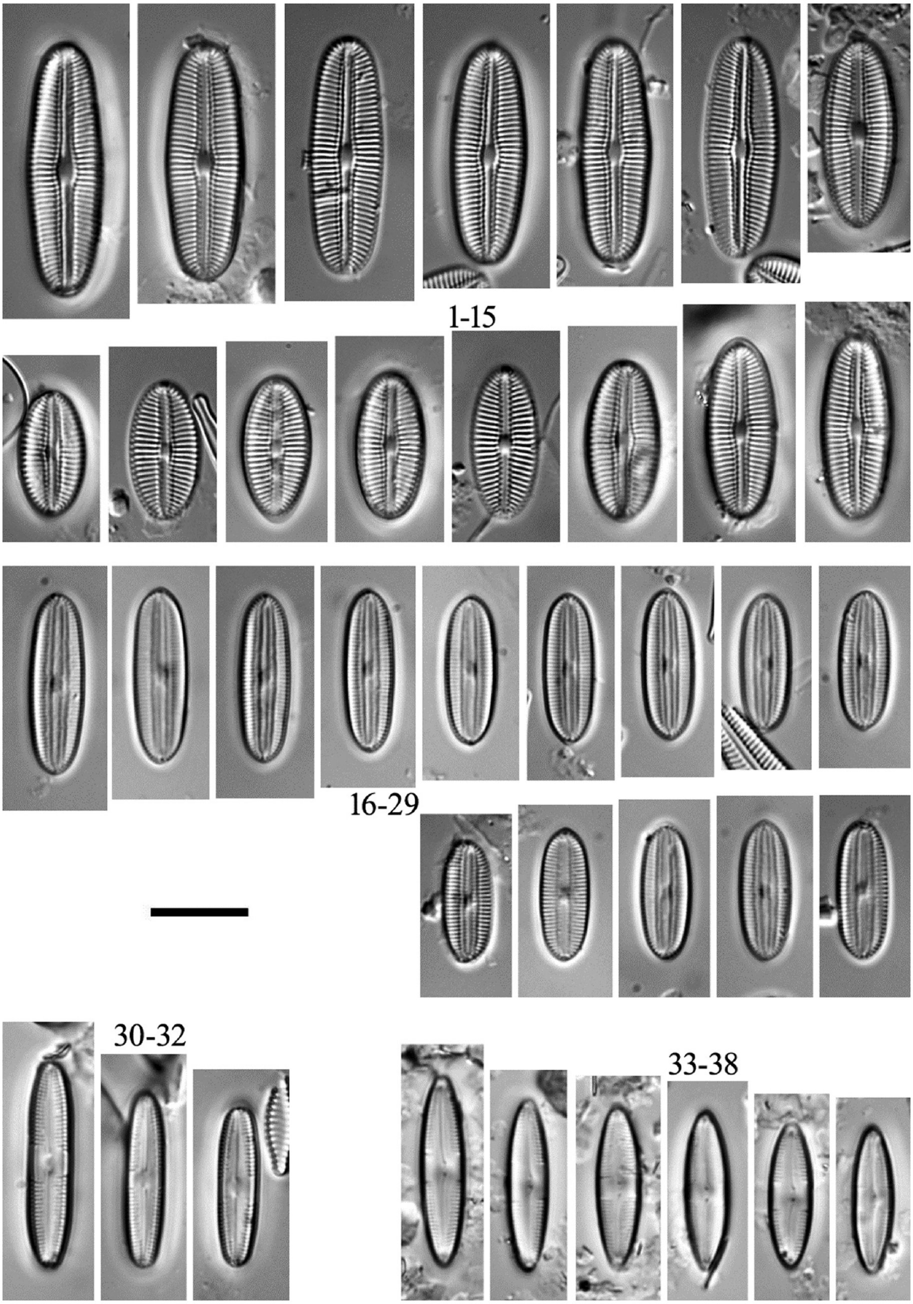

Plate 65 – *Diploneis praetermissa* Lange-Bertalot & Furhmann (1.–15.), *Diploneis oculata* (Brébisson) A. Cleve (16.–29.), *Caloneis fontinalis* (Grunow) Lange-Bertalot & E. Reichardt (30.–32.), *Caloneis lancettula* (E. Schulz) Lange-Bertalot & A. Witkowski (33.–38.).

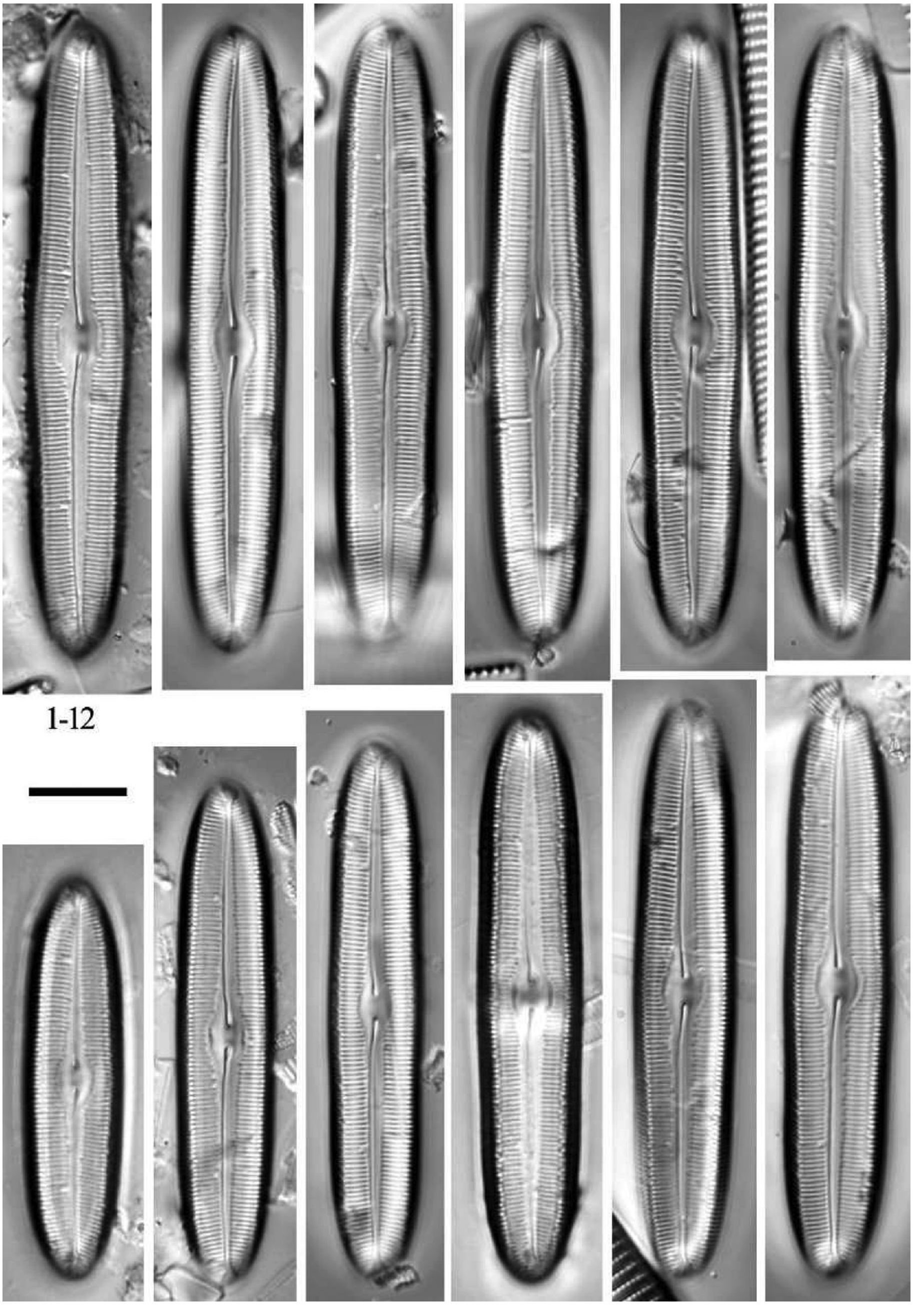

Plate 66 – *Caloneis alpestris* (Grunow) Cleve (1.–26.).

PLATE 67. *Caloneis limosa* (Ehrenberg) Patrick, *Caloneis* sp. 1.

Figs 1–3. *Caloneis limosa* (Ehrenberg) Patrick

Valves are linear and biconsticted with convex margin in the mid-valve and narrowly rounded apices. Valve length 62–72 μm, valve width 13.0–14.5 μm. Axial area moderately wide, lanceolate, tapering towards valve apices. Central area broad and round. Lunate markings (maculae) are absent in the central area. Raphe weakly lateral, becoming filiform towards the ends. Central pores large unilaterally deflected towards the primary valve side. Striae parallel in mid-valve, becoming radiate towards apices, 17–18 in 10 μm. Longitudinal bands visible in LM, located near valve margins.

Caloneis limosa is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 4–14. *Caloneis* sp. 1.

Valves are linear to linear-lanceolate with almost parallel to slightly convex margins in the mid-valve and narrowly rounded apices. Valve length 32–47 μm, valve width 7.0–8.0 μm. Axial area moderately wide, lanceolate, tapering towards valve apices. Central area broad, rectangular fascia. Lunate markings (maculae) are present in the central area. Raphe weakly lateral, becoming filiform towards the ends. Central pores large unilaterally deflected towards the primary valve side. Striae parallel in mid-valve, becoming radiate towards apices, 18–22 in 10 μm. Longitudinal bands visible in LM, located near valve margins.

Caloneis sp. 1 appears very similar to *Caloneis falcifera* Lange-Bertalot, Genkal & Vekhov (Lange-Bertalot *et al.*, 2004), but it differs by larger valve size. Probably it is widely distributed in Asia since similar population was observed in Mongolia by Metzeltin *et al.* (2009). *Caloneis* sp. 1. was frequently observed in study area.

Scale bar = 10 μm
LM 1500x

Figs 1–14. Jiuzhaigou National nature reserve, sample Acc. No. 67 – 1Ah.

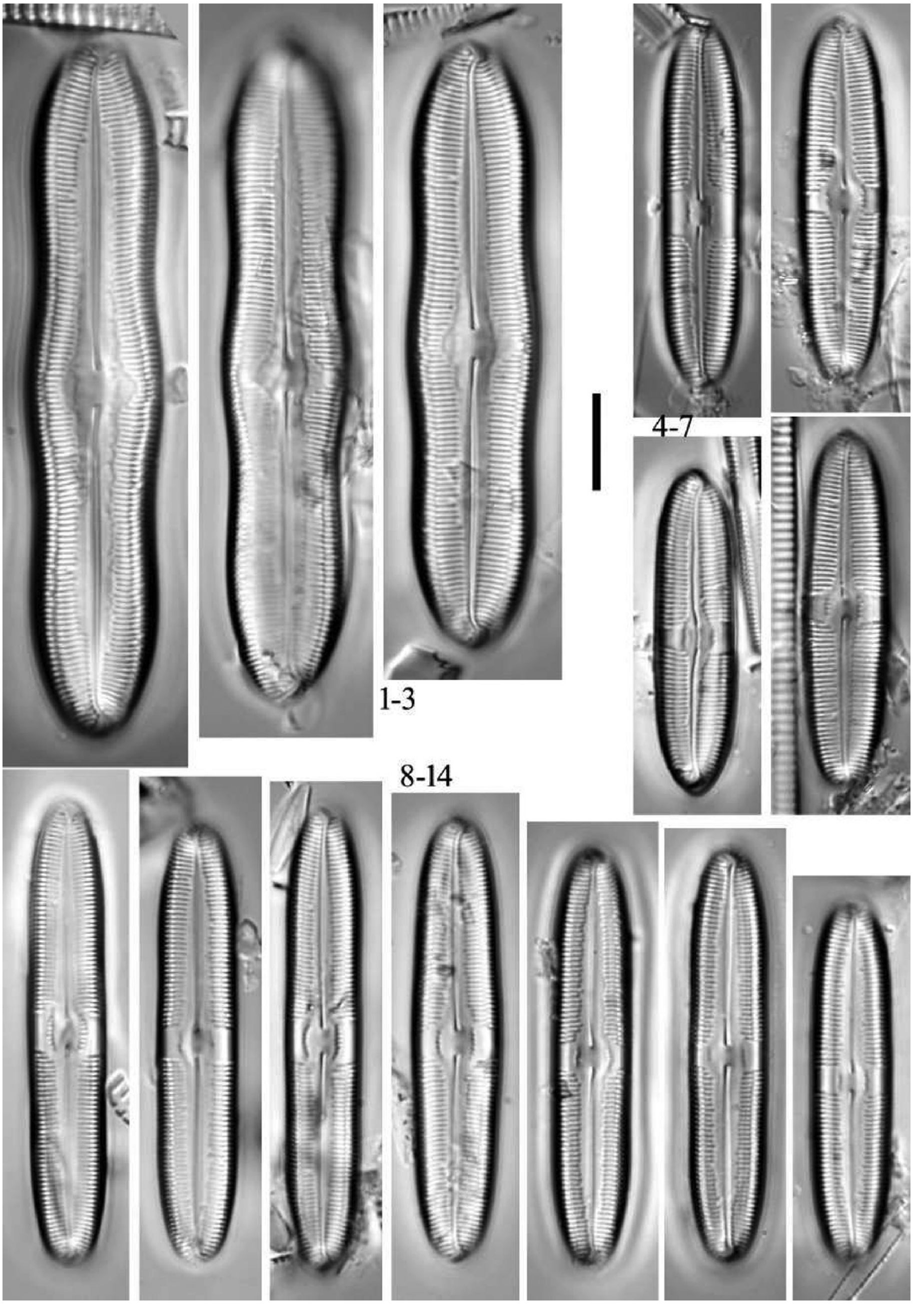

Plate 67 – *Caloneis limosa* (Ehrenberg) Patrick (1.–3.), *Caloneis* sp. 1. (4.–14.).

PLATE 68. *Caloneis undulata* (Gregory) Krammer

Figs 1–27. *Caloneis undulata* (Gregory) Krammer

Valves are linear with weakly undulated valve margins and subprortacted to subcapitate apices. Valve length 26–44 μm, valve width 4.5–6.0 μm. Axial area narrow, linear, slightly widened near the central area. Central area moderately broad, bilateral fascia, rarely unilateral fascia or absent. Lunate markings (maculae) are absent in the central area. Raphe weakly lateral, becoming filiform towards the ends. Central pores large unilaterally deflected towards the primary valve side. Striae parallel in mid-valve, becoming convergent towards apices, 20–22 in 10 μm. Longitudinal bands not clearly visible in LM, located near valve margins.

Caloneis undulata is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–27. Jiuzhaigou National nature reserve, sample Acc. No. 57 – H PER1 and sample Acc. No. 9.

PLATE 69. *Caloneis falcifera* Lange-Bertalot, Genkal & Vekhov, *Caloneis* sp. aff. *undulata* (Gregory) Krammer

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Figs 1–15. *Caloneis falcifera* Lange-Bertalot, Genkal & Vekhov

Valves are linear to linear-lanceolate with almost parallel to slightly convex margin in the mid-valve and narrowly rounded apices. Valve length 32–47 μm, valve width 5.0–6.5 μm. Axial area moderately wide, lanceolate, tapering towards valve apices. Central area is broad, rectangular fascia. Lunate markings (maculae) are present in the central area. Raphe is weakly lateral, becoming filiform towards the ends. Central pores are large unilaterally deflected towards the primary valve side. Striae are parallel in mid-valve, becoming radiate towards apices, 18–22 in 10 μm. Longitudinal bands are visible in LM, located near valve margins.

Caloneis undulata is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 16–24. *Caloneis* sp. aff. *undulata* (Gregory) Krammer

Valves are linear with distinctly undulated valve margins and capitate to subcapitate apices. Valve length 29–44 μm, valve width 5.0–6.0 μm. Axial area narrow, linear, slightly widened near the central area. Central area variable, broad to narrow, panduriform fascia, rarely unilateral fascia or absent. Lunate markings (maculae) are absent in the central area. Raphe is weakly lateral, becoming filiform towards the ends. Central pores are large unilaterally deflected towards the primary valve side. Striae radiate to slightly radiate in mid-valve, becoming convergent towards apices, 20–22 in 10 μm. Longitudinal bands visible in LM, located near valve margins.

This taxon appears similar to *C. undulata*, but small differences can be noticed in the shape of the valve apices. Additional observations are necessary to determine possible conspecificity of both taxa.

Scale bar = 10 μm
LM 1500x

Figs 1–24. Jiuzhaigou National nature reserve, sample Acc. No. 57 – H PER1.

PLATE 70. *Pinnularia viridis* (Nitzsch) Ehrenberg, *Pinnularia subcommutata* var. *nonfasciata* Krammer, *Pinnularia divergens* W. Smith, *Pinnularia grunowii* Krammer, *Pinnularia divergentissima* (Grunow) Cleve

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Fig. 1. *Pinnularia viridis* (Nitzsch) Ehrenberg
LM 1200x
Fig. 2. *Pinnularia subcommutata* var. *nonfasciata* Krammer
Figs 3–5. *Pinnularia divergens* W. Smith

Valves are linear-lanceolate with slightly protracted to subcapitate apices. Valve length is 54–70 μm, valve width is 11.5–14.5 μm. Axial area is moderately wide, lanceolate, widening towards the central area. Central area is broad, rhombic to round. Raphe distinctly lateral, becoming filiform towards the ends. Central pores are large unilaterally deflected towards the primary valve side. Striae strongly radiate in the mid-valve, becoming convergent towards apices, 10–11 in 10 μm.

Pinnularia divergens is considered as a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 6, 7. *Pinnularia grunowii* Krammer
Figs 8–12. *Pinnularia divergentissima* (Grunow) Cleve

Valves are linear-lanceolate with slightly protracted to subcapitate apices. Valve length 22–27 μm, valve width 4.5–5.5 μm. Axial area is narrow, lanceolate, widened near the central area. Central area is broad, panduriform fascia. Raphe slightly lateral, becoming filiform towards the ends. Central pores are large unilaterally deflected towards the primary valve side. Striae strongly radiate in the mid-valve, becoming strongly convergent towards apices, 14–16 in 10 μm.

Pinnularia divergentissima is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x Figs 2.–12.

Figs 1–12. Jiuzhaigou National nature reserve, sample Acc. No. 57 – H PER1.

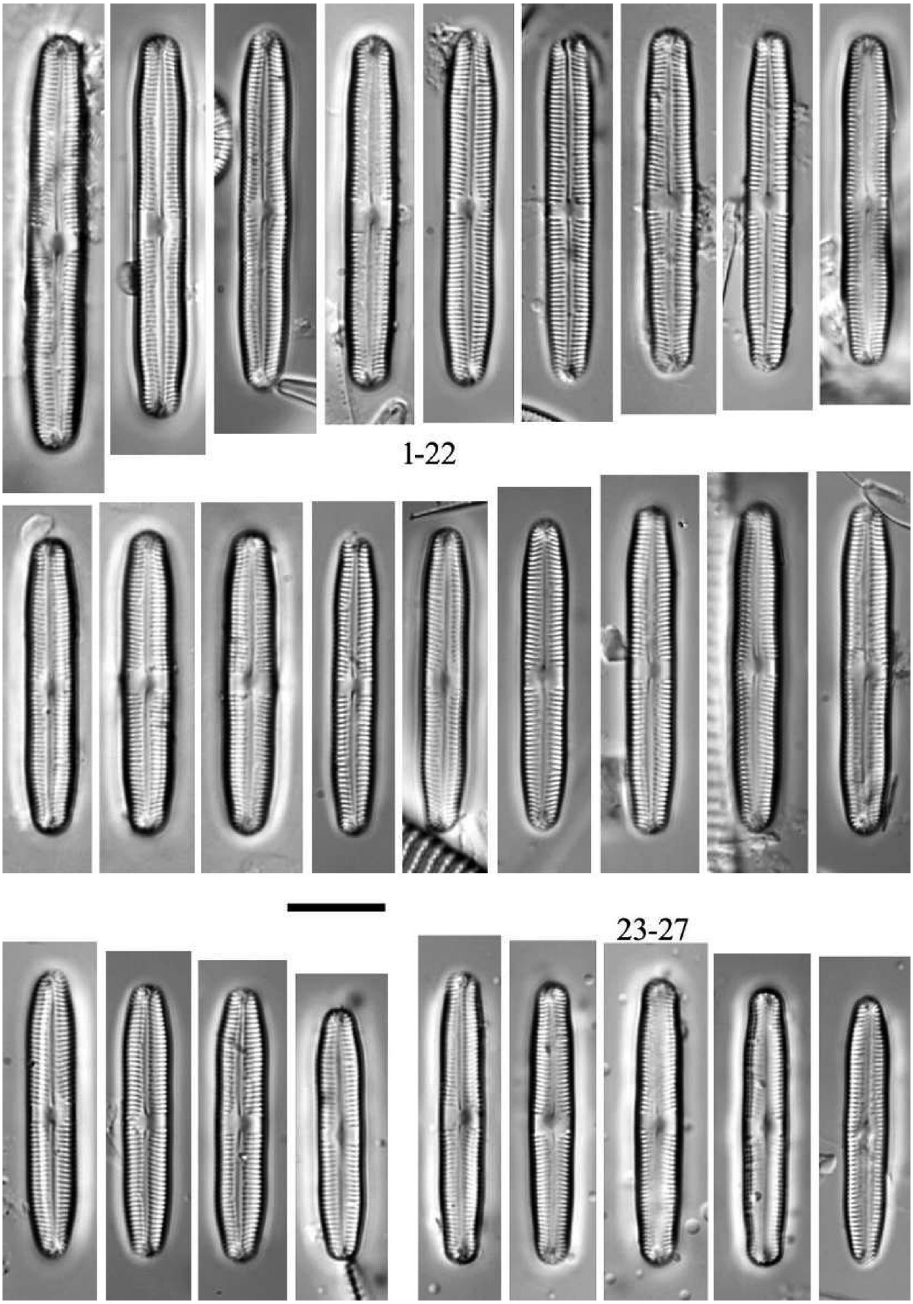

Plate 68 – *Caloneis undulata* (Gregory) Krammer (1.–27.).

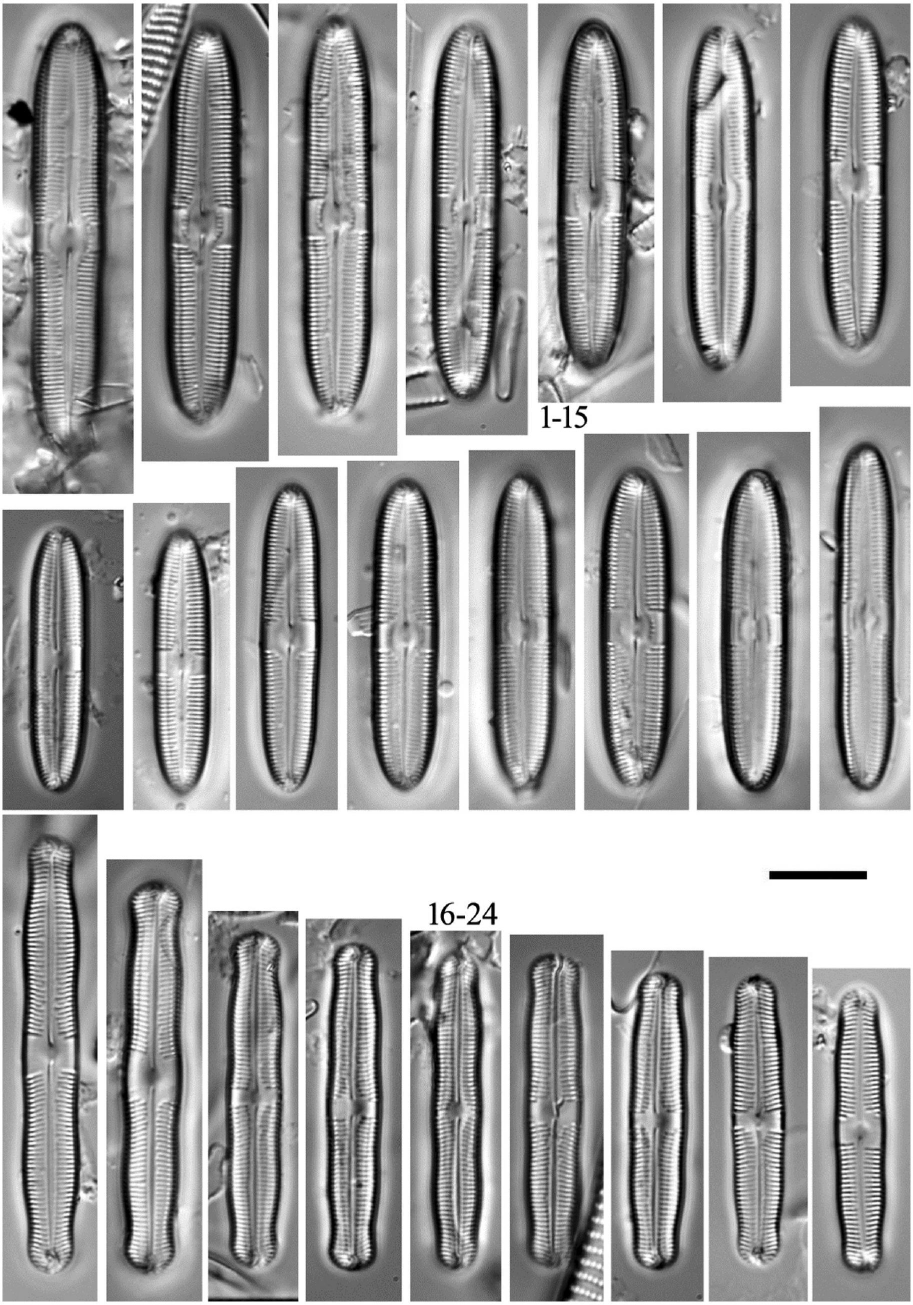

PLATE 69 – *Caloneis falcifera* Lange-Bertalot, Genkal & Vekhov (1.–15.), *Caloneis* sp. aff. *undulat*a (Gregory) Krammer (16.–24.).

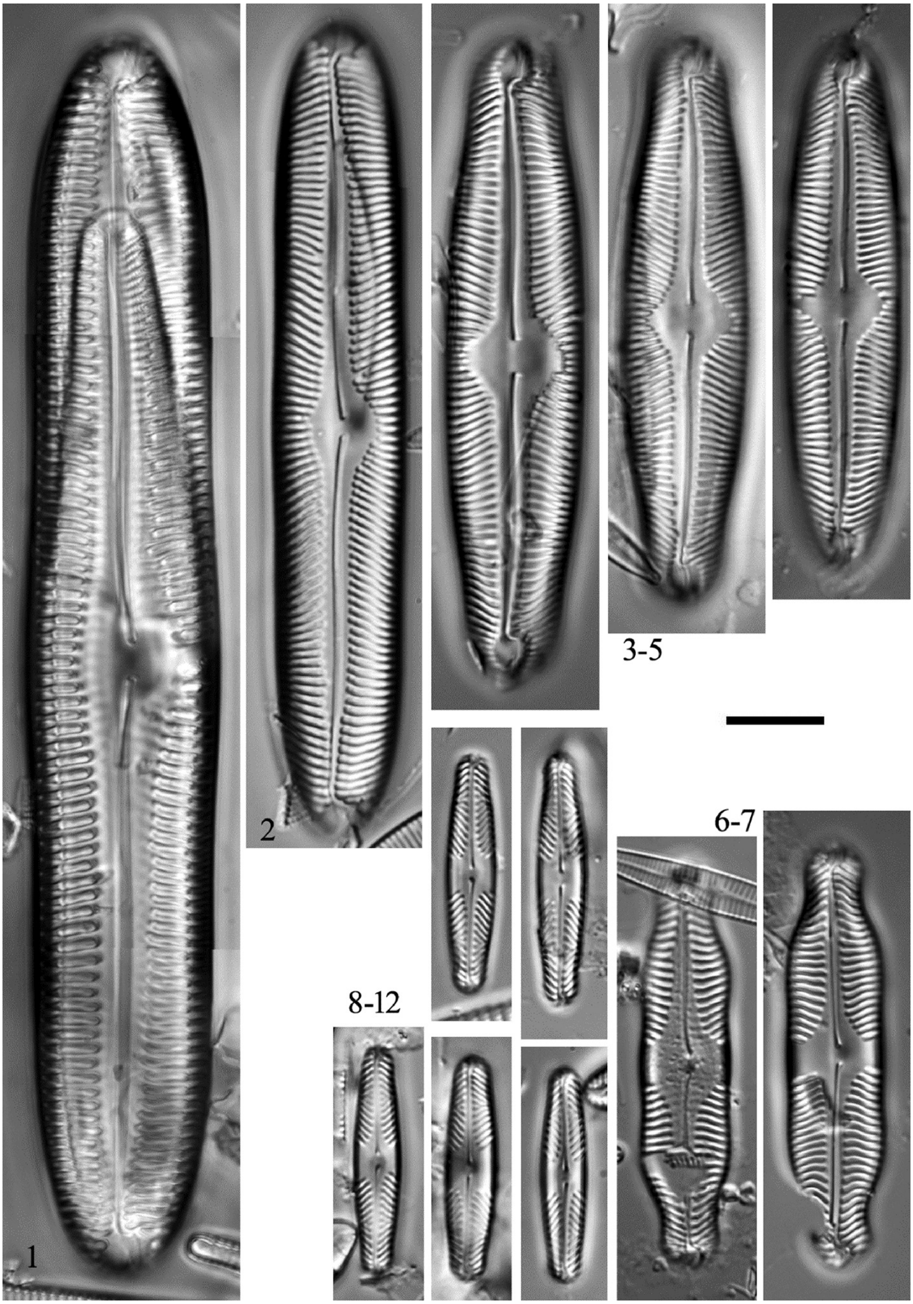

Plate 70 – *Pinnularia viridis* (Nitzsch) Ehrenberg (1.), *Pinnularia subcommutata* var. *nonfasciata* Krammer (2.), *Pinnularia divergens* W. Smith (3.–5.), *Pinnularia grunowii* Krammer (6., 7.), *Pinnularia divergentissima* (Grunow) Cleve (8.–12.).

PLATE 71. *Sichuaniella lacustris* (Y.-L. Li, Lange-Bertalot & Metzeltin) Li Yanling, Lange-Bertalot & Metzeltin

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Figs 1–53. *Sichuaniella lacustris* (Y.-L. Li, Lange-Bertalot & Metzeltin) Li Yanling, Lange-Bertalot & Metzeltin

Frustules are isovalvate, very narrow, and rectangular. Cells are solitary. Valves are broadly elliptical with rounded apices. Valve length is 9–24 μm, valve width is 5.5–8.0 μm. Axial area is relatively narrow, lanceolate. Central area is not differentiated from axial area and it is with same width as the axial area. Raphe is linear to slightly curved, with central pores distantly spaced. Two dark spots slightly distally displaced from the proximal raphe ends are present. Transapical striae are coarse, 10–11 in 10 μm. Areolae are not discernible with LM.

Sichuaniella is endemic genus for P.R. China (Georgiev *et al.*, 2015; Yanling *et al.*, 2009). So far only two species are known: *Sichuaniella lacustris* and *Sichuaniella deqinensis* Wu, Zhang, Li, Metzeltin, Lange-Bertalot & Kociolek (Wu *et al.*, 2020). In the study area, *S. lacustris* is frequently observed, and in the sample Acc. No. 32 is one of sub-dominant species.

Scale bar = 10 μm
LM 1500x

Figs 1–53. Jiuzhaigou National nature reserve, sample Acc. No. 32.

PLATE 72. *Stauroneis* sp. 1. nov.

Figs 1–21. *Stauroneis* sp. 1. nov.

Valves are elliptic-lanceolate with abruptly protracted, rostrate to subcapitate apices. Valve length is 36–42 μm, valve width is 9.0–10.5 μm. The axial area is moderately wide and nearly linear, widening a bit near the central area. The central area is transversally elliptic, bordered by several central striae. The raphe is moderately lateral. Proximal raphe ends are nearly straight, terminated by small, weakly inflated pores. Striae radiate throughout 16–20 in 10 μm. Areolae are densely spaced and not discernible with LM.

The genus Stauroneis is widely distributed in Europe and Asia and it is one of the largest diatom genera. Most Stauroneis species are characterized by presence of large rectangular to pandurform central area (fascia), known as “stauros”. *Stauroneis* sp. 1. nov. is characterized by transversally elliptical central area bordered with central striae from both valve sides. Only few species have such shaped central area, and based on available literature *Stauroneis* sp. 1 differs by its morphometrical features. It is supposed that this taxon is endemic to the study area. It was observed only in one sample Acc. No. 57 – H PER1.

Scale bar = 10 μm
LM 1500x

Figs 1–21. Jiuzhaigou National nature reserve, sample Acc. No. 57 – H PER1.

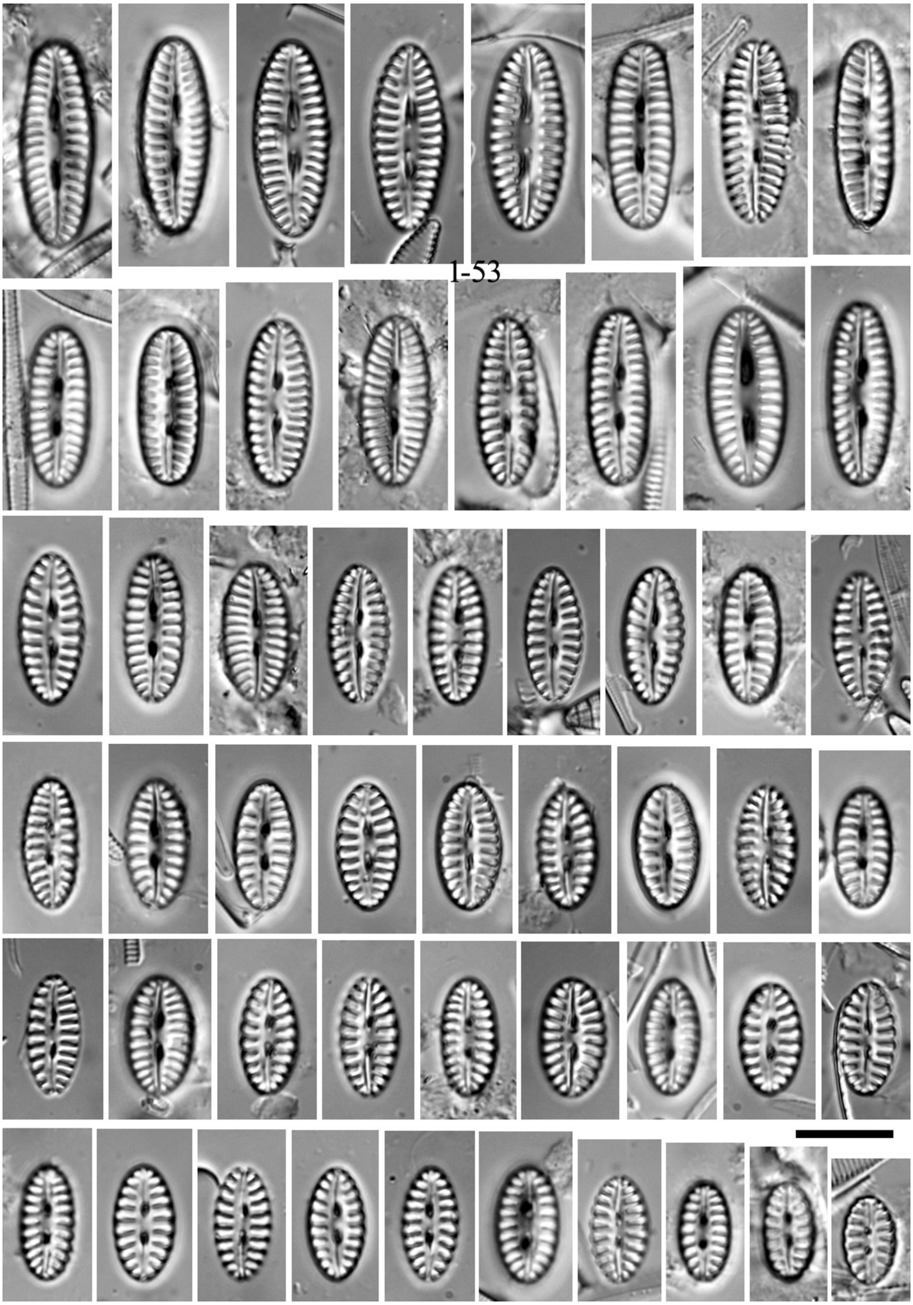

Plate 71 – *Sichuaniella lacustris* (Y.-L. Li, Lange-Bertalot & Metzeltin) Li Yanling, Lange-Bertalot & Metzeltin (1.–53.).

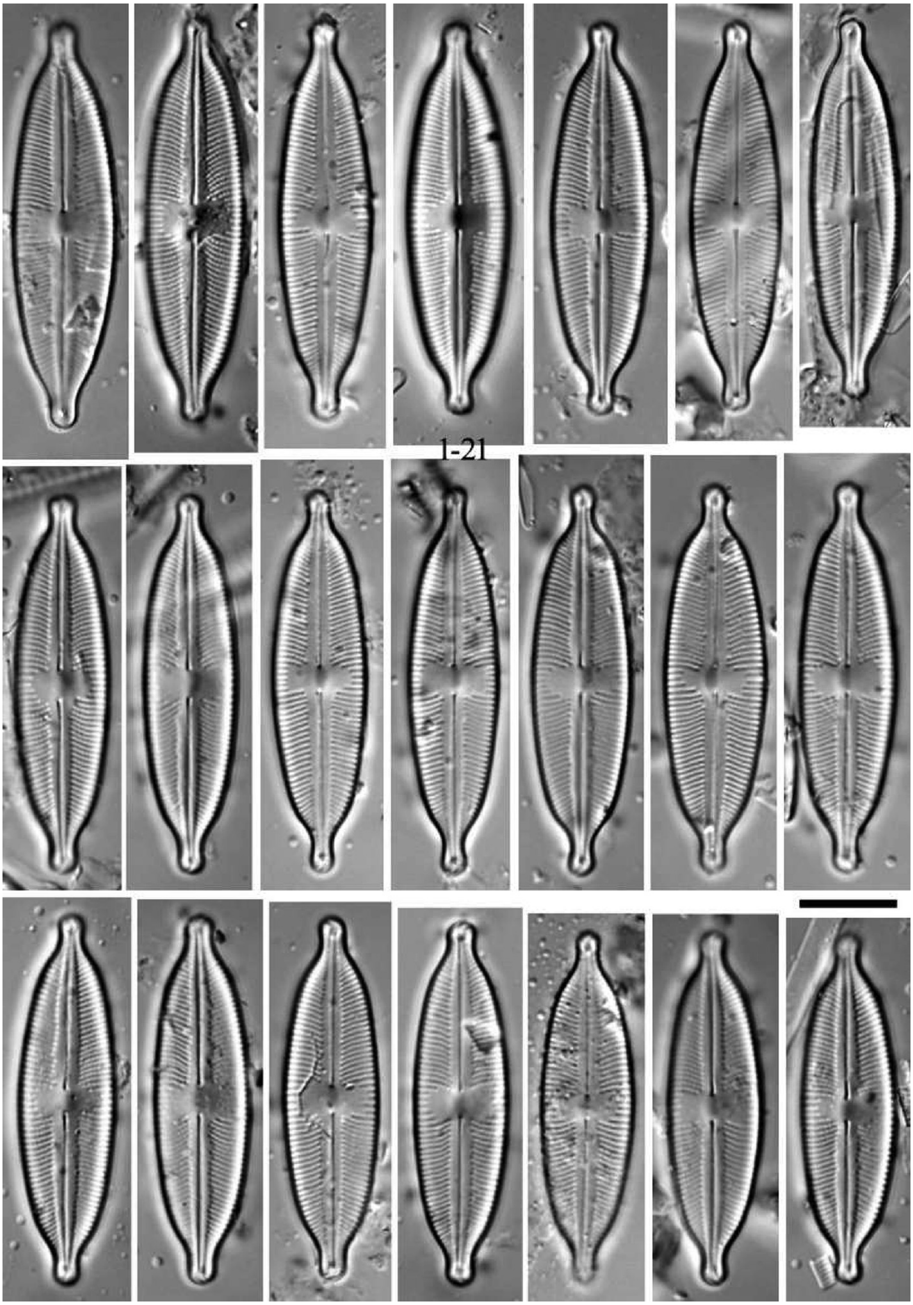

PLATE 72 – *Stauroneis* sp. 1. nov. (1.–21.).

PLATE 73. *Mastogloia lacustris* (Grunow) Van Heurck

Figs 1–20. *Mastogloia lacustris* (Grunow) Van Heurck

Frustules in girdle view are rectangular. Valves are linear-lanceolate to elliptic-lanceolate. Valve margins are moderately to strongly convex and rarely weakly convex. Transition of valve face towards valve mantle is gradual. Valve ends are rounded, shortly protracted in longer specimens to not protracted in shortest specimens. Valve length is 26.5–49.0 μm, and valve width is 8.5–10.5 μm. Axial area very is narrow, linear, central area is transversally elliptical to round. Raphe is slightly lateral, and weakly or irregularly sinusoid. Proximal raphe ends are simple, curved towards one valve side. Striae parallel to weakly radiate at mid-valve, becoming radiate towards apices, 15–17 in 10 μm. Areolae are small and round, clearly discernible in LM. Partectal ring and the edge of the intrapartectal cylinder clearly are visible in LM at critical focus. Individual partecta are small and rectangular, transapically elongated, next to valve margins. Partecta at both valve margins isomorphic and of equal number, 6–7 in 10 μm.

Mastogloia lacustris is considered a widely spread (cosmopolitan) species (Pavlov *et al.*, 2016), and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–20. Jiuzhaigou National nature reserve, sample Acc. No. 32 – 3J.

PLATE 74. *Encyonema silesiacum* (Bleisch) D.G. Mann

Figs 1–31. *Encyonema silesiacum* (Bleisch) D.G. Mann

Valves are dorsiventral, with dorsal margin strongly arched and ventral margin straight or slightly tumid in the mid-valve. Valve ends are narrowly rounded and weakly ventrally bent. Valve length is 21–42 μm, valve width is 6.5–9.5 μm. The axial area is narrow and confluent with a slightly wider central area. A single stigmoid is present at the proximal end of the middle dorsal stria. Proximal raphe ends are slightly inflated and deflected dorsally. Distal raphe ends are curved toward the ventral margin. Dorsal striae are radiate, 12–15 in 10 μm. Ventral striae radiate near the valve center, becoming convergent toward the apices. Areolae are discernible with LM, 28–32 in 10 μm.

Encyonema silesiacum is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–31. Jiuzhaigou National nature reserve, sample Acc. No. 67 – 1Ah.

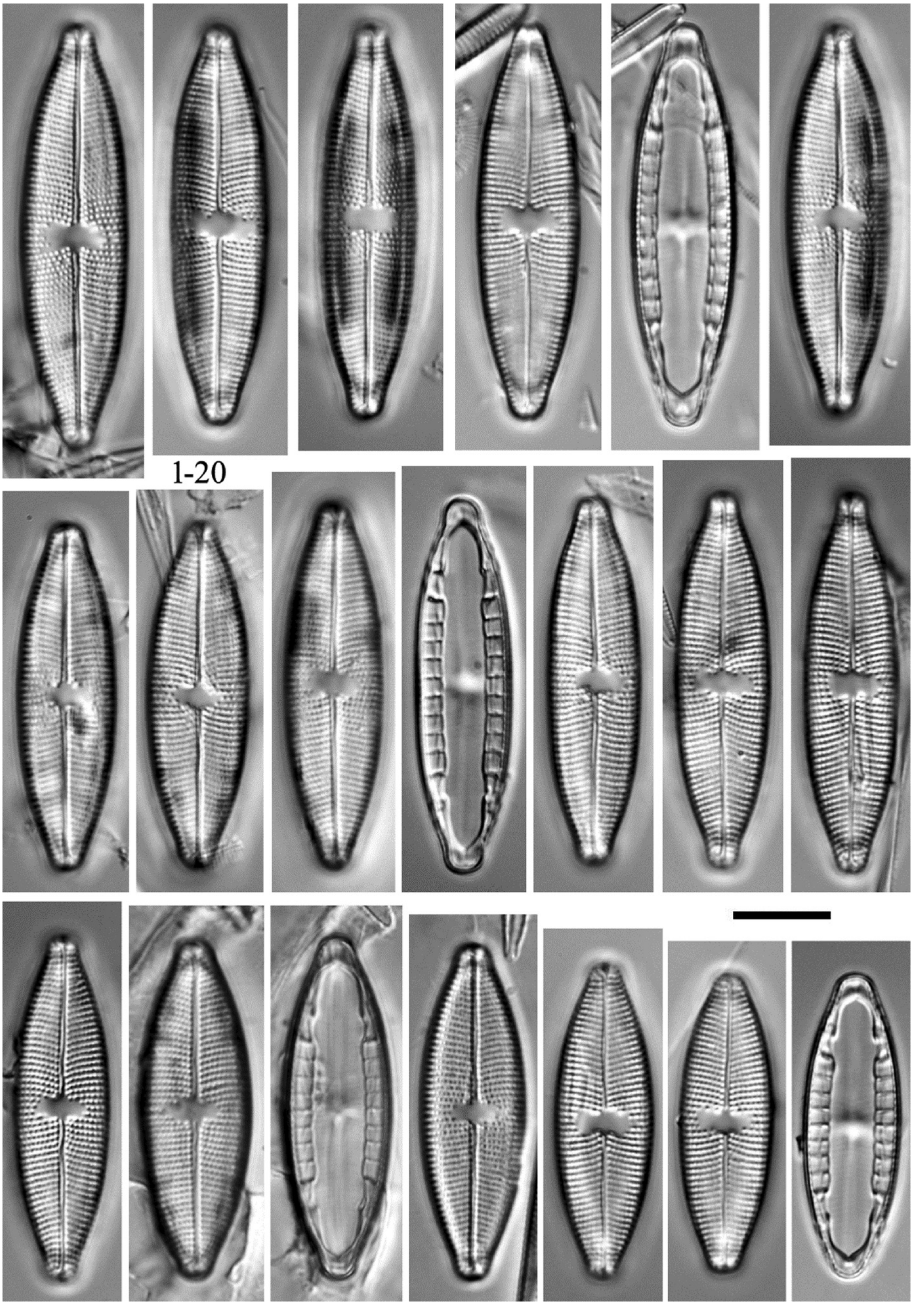

PLATE 73 – *Mastogloia lacustris* (Grunow) Van Heurck (1.–20.).

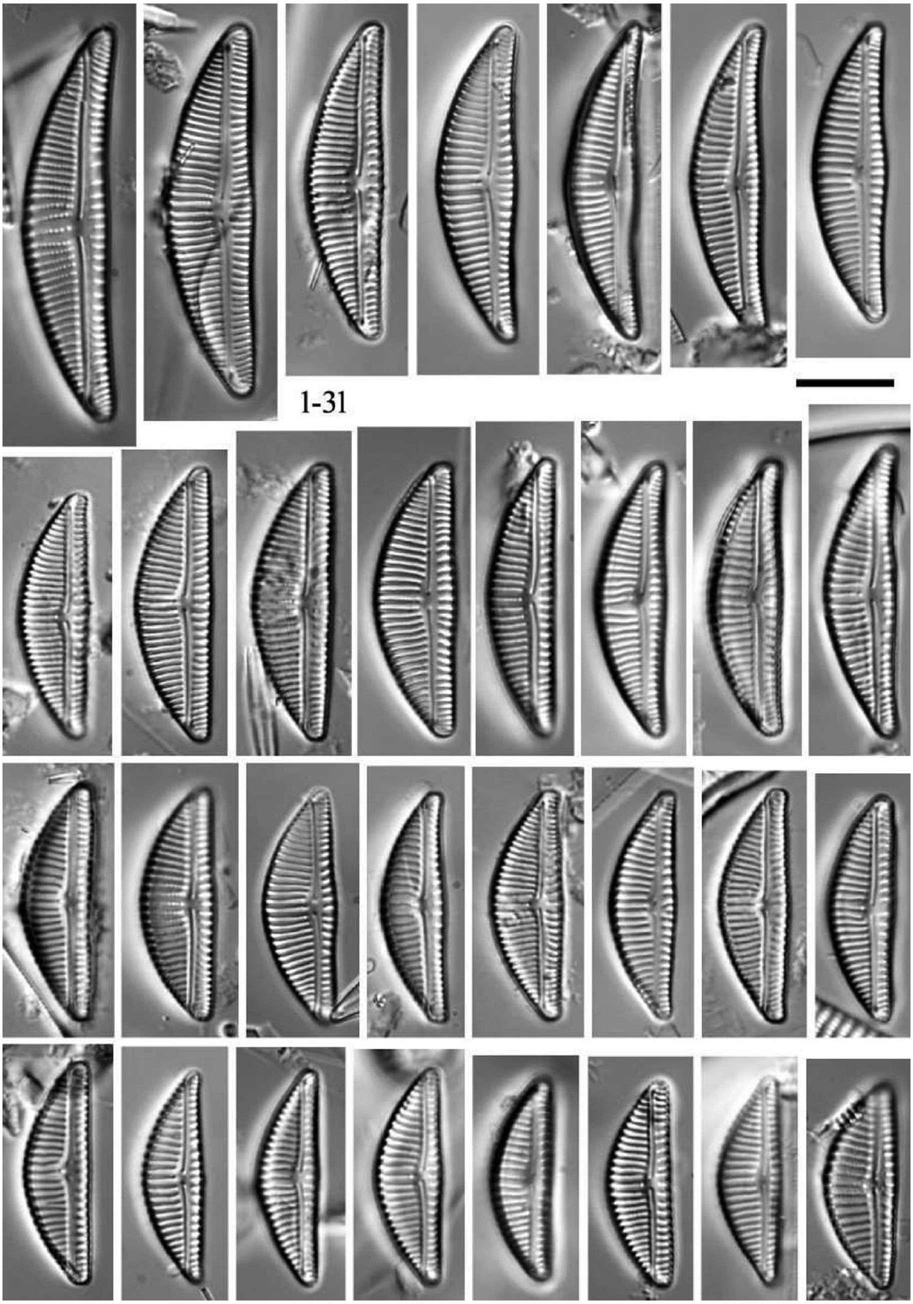

PLATE 74 – *Encyonema silesiacum* (Bleisch) D.G. Mann (1.31.).

PLATE 75. *Encyonema ventricosum* (C. Agardh) Grunow, *Encyonema* sp., *Encyonema minutum* (Hilse) D.G. Mann, *Encyonema oblonga* Q. Lui & S. Xie, *Encyonopsis subminuta* Krammer & E. Reichardt, *Cymbella lancettula* (Krammer) Krammer, *Cymbella stigmaphora* Østrup, *Cymbella neoleptoceros* Krammer

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Figs 1–13. *Encyonema ventricosum* (C. Agardh) Grunow

Valves are dorsiventral, with dorsal margin strongly arched and ventral margin slightly concave and tumid in the mid-valve. Valve ends are narrowly rounded and distinctly ventrally bent. Valve length is 11–18 μm, valve width is 4.0–4.5 μm. The axial area is narrow and confluent with a slightly wider central area. A single stigmoid is present at the proximal end of the middle dorsal stria. Proximal raphe ends are deflected dorsally. Distal raphe ends are curved toward the ventral margin. Dorsal striae are slightly radiate, 16–18 in 10 μm. Ventral striae radiate near mid-valve, becoming convergent toward the apices.

Fig. 14. *Encyonema* sp.

Fig. 15. *Encyonema minutum* (Hilse) D.G. Mann

Fig. 16. *Encyonema* sp.

Fig. 17. *Encyonema oblonga* Q. Lui & S. Xie

This species was recently described from Shanxi Province, Manghe National Nature Reserve by Liu *et al.* (2021). In the study area, only one valve was recorded.

Figs 18–22. *Encyonopsis subminuta* Krammer & E. Reichardt

Figs 23–25. *Cymbella lancettula* (Krammer) Krammer

Figs 26–28. *Cymbella stigmaphora* Østrup

Valves are dorsiventral and rhombic-lanceolate with rounded apices. The dorsal margin is strongly arched and ventral margin is weakly convex and tumid in the middle. The axial is moderately wide. The central area is wider than the axial area. A stigma is absent in central area. The raphe is distinctly lateral. The proximal raphe terminates with slightly inflated pores. Distal raphe fissures are deflected dorsally. Striae are radiated, 9–12 in 10 μm, becoming more strongly radiated near the valve apices. Areolae are discernible in LM, 22–6 in 10 μm.

Figs 29, 30. *Cymbella neoleptoceros* Krammer

Scale bar = 10 μm
LM 1500x

Figs 1–30. Jiuzhaigou National nature reserve, various samples.

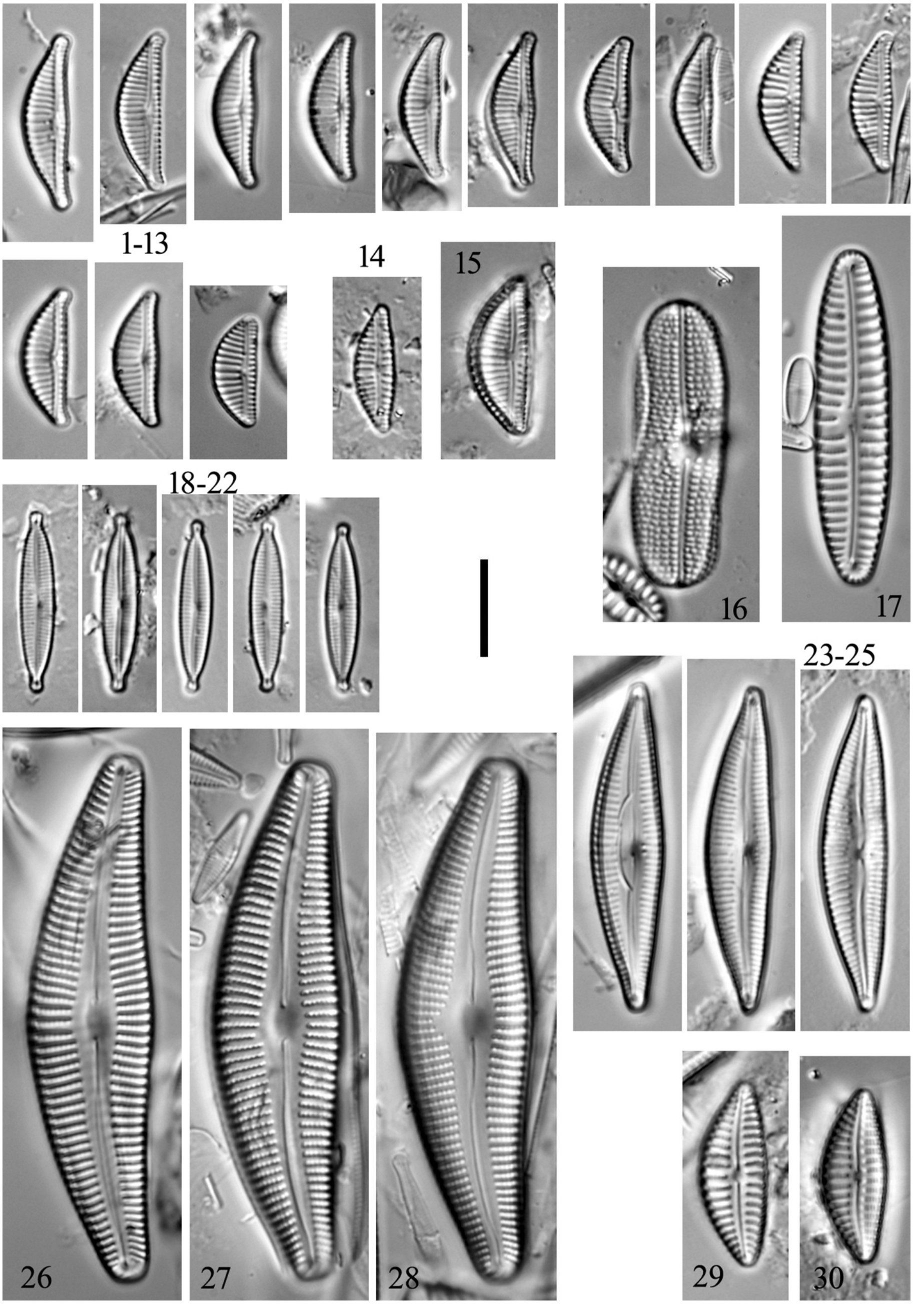

Plate 75 – *Encyonema ventricosum* (C. Agardh) Grunow (1.–13.), *Encyonema* sp. (14.), *Encyonema minutum* (Hilse) D.G. Mann (15.), *Encyonema* sp. (16.), *Encyonema oblonga* Q. Lui & S. Xie (17.), *Encyonopsis subminuta* Krammer & E. Reichardt (18.–22.), *Cymbella lancettula* (Krammer) Krammer (23.–25.), *Cymbella stigmaphora* Østrup (26.–28.), *Cymbella neoleptoceros* Krammer (29., 30.).

PLATE 76. *Encyonopsis cesatiformis* Krammer

Figs 1–20. *Encyonopsis cesatiformis* Krammer

Valves are slightly dorsiventral, narrowly lanceolate with both valve margins slightly convex. Valve ends are slightly protracted and narrowly rounded. Valve length is 41–60 μm, valve width is 6.0–7.5 μm. The axial area is narrow. The central area is broad, elliptic to round. Raphe is distinctly lateral becoming reverse lateral towards proximal raphe ends. Proximal raphe ends are slightly inflated and deflected dorsally. Distal raphe ends are curved toward the ventral margin. Dorsal striae are radiate, 16–17 in 10 μm. Ventral striae weakly radiate near the valve center, becoming more radiate toward the apices. Areolae are hardly discernible with LM, 28–32 in 10 μm.

Encyonopsis cesatiformis is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–20. Jiuzhaigou National nature reserve, sample Acc. No. 9.

PLATE 77. *Encyonopsis cesatii* (Rabenhorst) Krammer

Figs 1–32. *Encyonopsis cesatii* (Rabenhorst) Krammer

Valves are slightly dorsiventral, narrowly lanceolate with both valve margin slightly convex. Valve ends are slightly protracted and narrowly rounded. Valve length is 23–39 μm, valve width is 4.0–5.5 μm. The axial area is narrow. The central area is variable, slightly asymmetric, and elliptic to round. Raphe is distinctly lateral becoming filiform towards proximal raphe ends. Proximal raphe ends are slightly inflated and deflected dorsally. Distal raphe ends are curved toward the ventral margin. Dorsal striae are radiate, 18–20 in 10 μm. Ventral striae weakly radiate near the valve centre, becoming more radiate toward the apices. Areolae are not discernible with LM, 35–40 in 10 μm.

Encyonopsis cesatii is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–32. Jiuzhaigou National nature reserve, sample Acc. No. 11.

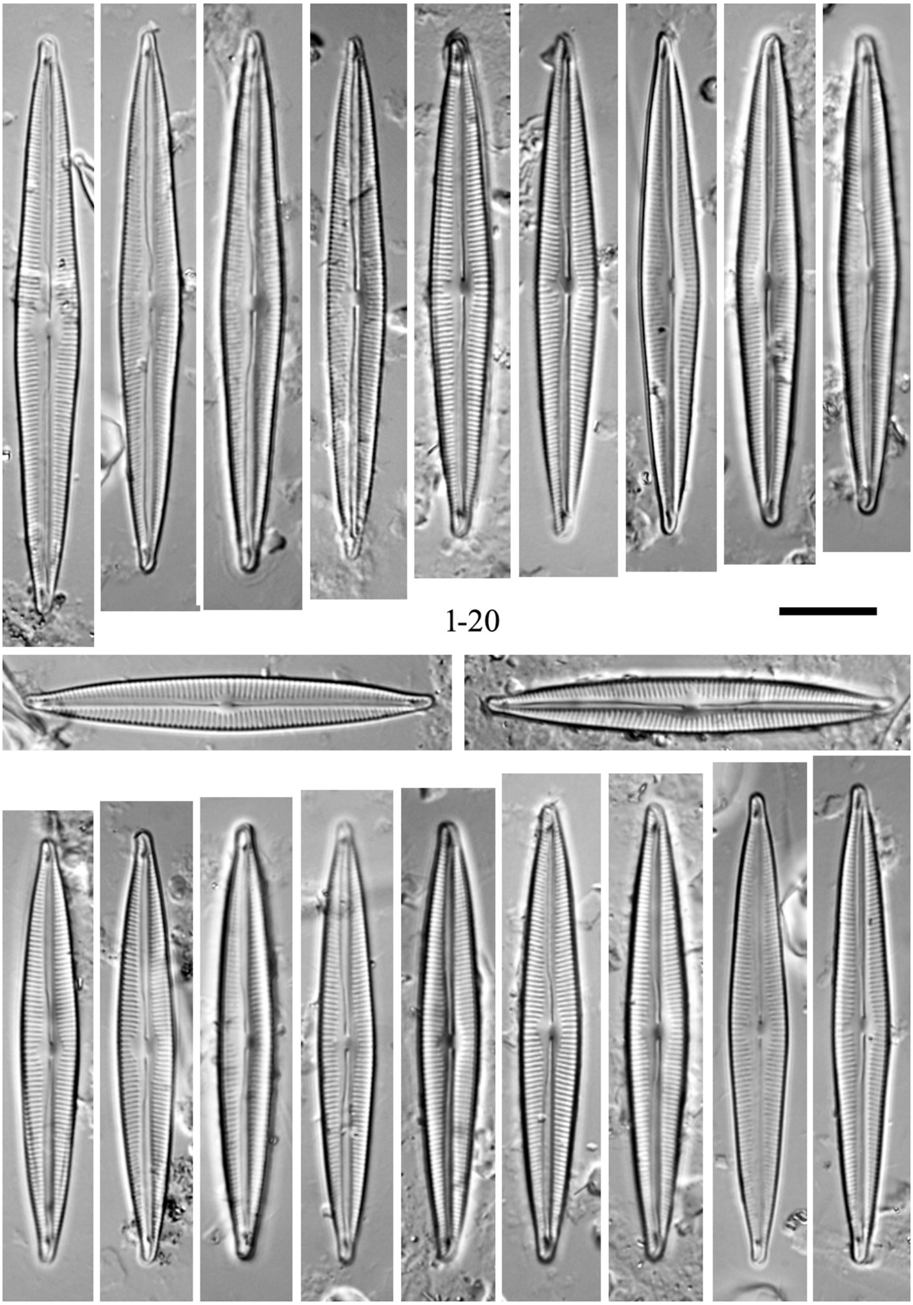

Plate 76 – *Encyonopsis cesatiformis* Krammer (1.–20.).

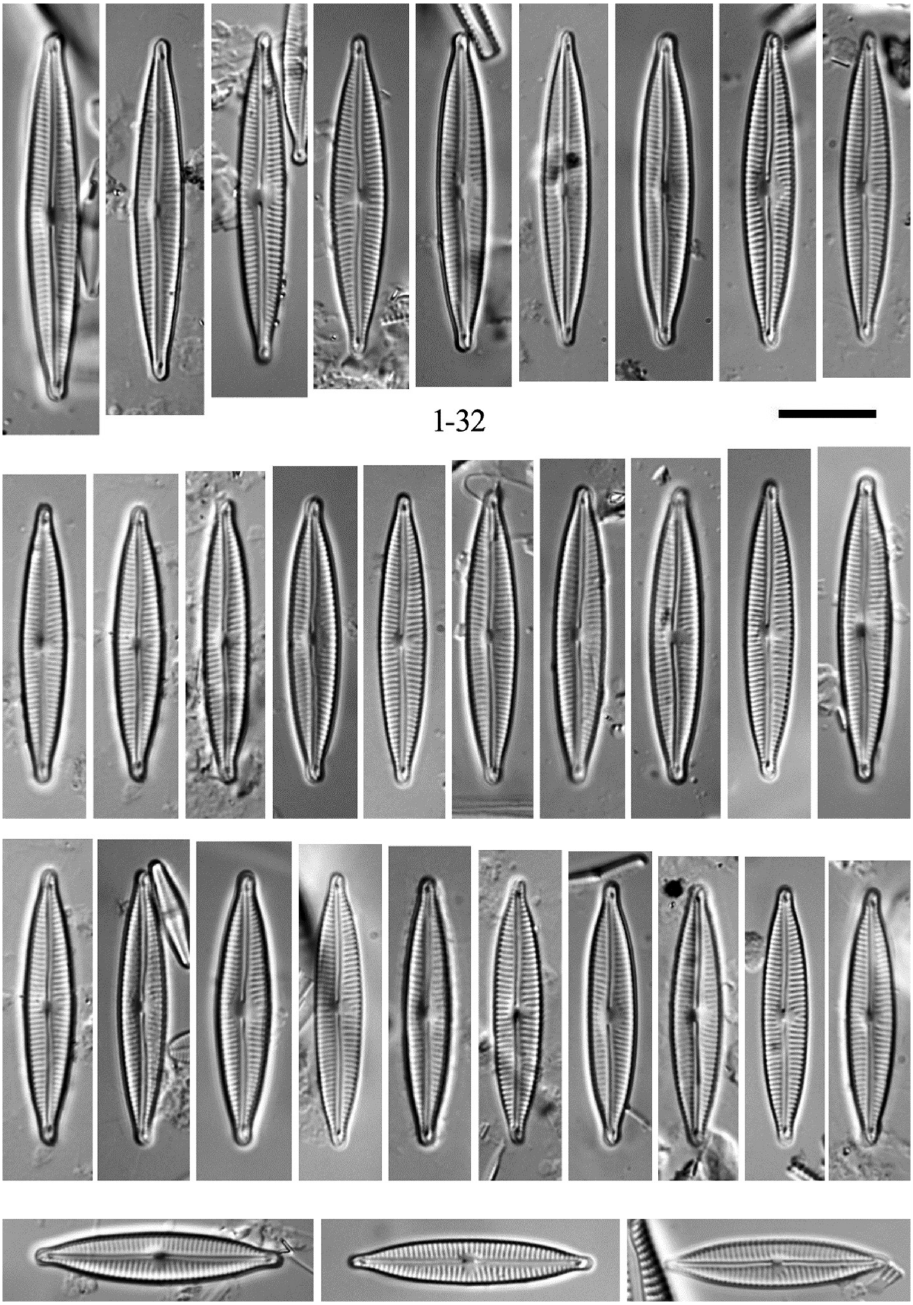

Plate 77 – *Encyonopsis cesatii* (Rabenhorst) Krammer (1.–32.).

PLATE 78. *Encyonopsis descripta* (Hustedt) Krammer

Figs 1–40. *Encyonopsis descripta* (Hustedt) Krammer

Valves are slightly dorsiventral, narrow, and linear-lanceolate with both valve margins slightly convex. Valve ends are distinctly protracted and capitate. Valve length is 15–30 μm, valve width is 4.0–6.0 μm. The axial area is narrow. The central area is variable, slightly asymmetric, and transversally elongated. Raphe is slightly lateral becoming filiform towards proximal raphe ends. Proximal raphe ends are slightly inflated and deflected dorsally. Distal raphe ends are curved toward the ventral margin. Dorsal striae are radiate, 18–20 in 10 μm. Ventral striae weakly radiate near the valve centre, becoming more radiate toward the apices. Areolae are not discernible with LM, 35–40 in 10 μm.

Encyonopsis descripta is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–40. Jiuzhaigou National nature reserve, sample Acc. No. 9.

PLATE 79. *Encyonopsis krammeri* E. Reichardt, *Encyonopsis microcephala* (Grunow) Krammer, *Encyonopsis subminuta* Krammer

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Figs 1–34. *Encyonopsis krammeri* E. Reichardt

Valves are narrowly lanceolate and moderately dorsiventral with rostrate to subcapitate apices that are deflected slightly ventrally. The dorsal margin is arched and the ventral margin is straight or weakly convex. Valve length is 12–20 μm, valve width is 3.0–4.0 μm. The axial area is narrow, linear. The central area is very small and continuous with the axial area. Raphe branches are filiform and bowed, concave to the dorsal margin. Proximal raphe ends are unexpanded and deflected dorsally. Distal raphe fissures are hooked toward the ventral margin. Striae weakly radiate 25–30 in 10 μm. Areolae not discernible with LM.

Encyonopsis krammeri is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 35–44. *Encyonopsis microcephala* (Grunow) Krammer

Valves are narrowly lanceolate and moderately dorsiventral with rostrate to subcapitate apices that are deflected slightly ventrally. The dorsal margin is arched and the ventral margin is straight or weakly convex. Valve length is 10–15 μm, valve width is 3.0–4.0 μm. The axial area is narrow, linear. The central area is very small and continuous with the axial area. Raphe branches are filiform and bowed, concave to the dorsal margin. Proximal raphe ends are unexpanded and deflected dorsally. Distal raphe fissures are hooked toward the ventral margin. Striae weakly radiate 22–25 in 10 μm. Areolae not discernible with LM.

Encyonopsis microcephala is considered a widely spread (cosmopolitan) species (Krammer, 1997b), and it was frequently observed in the samples from Jiuzhaigou National nature reserve

Figs 45–55. *Encyonopsis subminuta* Krammer

Scale bar = 10 μm
LM 1500x

Figs 1–44. Jiuzhaigou National nature reserve, sample Acc. No. 73 2eH
Figs 45–55. Various samples

PLATE 80. *Cymbella neocistula* Krammer

Figs 1–9. *Cymbella neocistula* Krammer

Valves are strongly dorsiventral, with dorsal margin strongly convex and ventral margin is linear to slightly curved and tumid at mid-valve. The valve ends are rounded and slightly protracted. Valve length is 45–80 μm, valve width is 13.0–17.5 μm. The axial area is narrow, expanding slightly into a moderately small and round central area. Stigmata 3–5 are present on the ventral side of the central area. The raphe is centrally located within the axial area. The raphe is reverse lateral, the proximal raphe ends are bent ventrally and slightly expanded. Striae are slightly radiate, 7–10 in 10 μm, distinctly punctate, with 16–22 areolae in 10 μm.

Cymbella neocistula is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 150x

Figs 1–9. Jiuzhaigou National nature reserve, sample Acc. No. 67 – 1Ah.

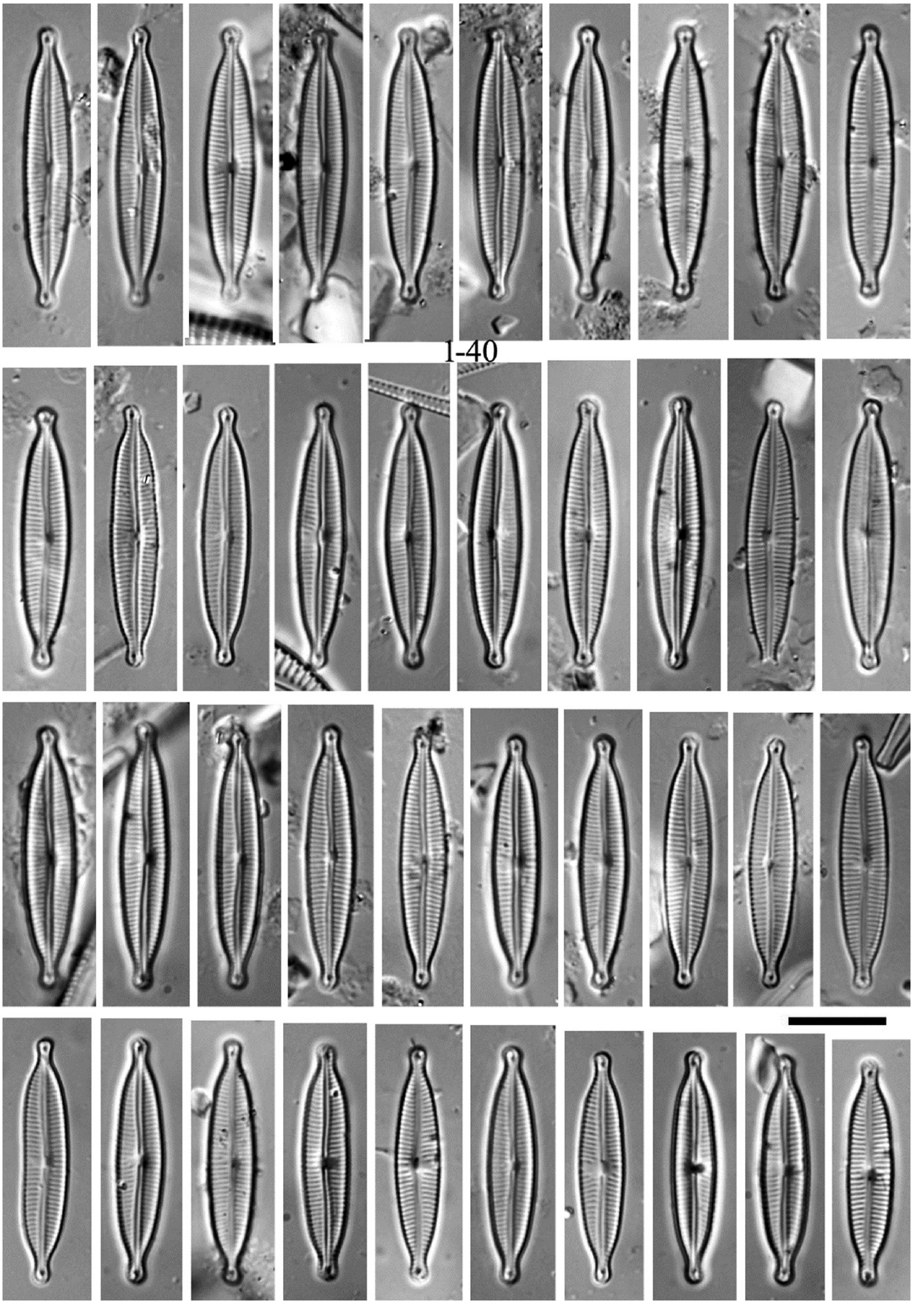

Plate 78 – *Encyonopsis descripta* (Hustedt) Krammer (1.–40.).

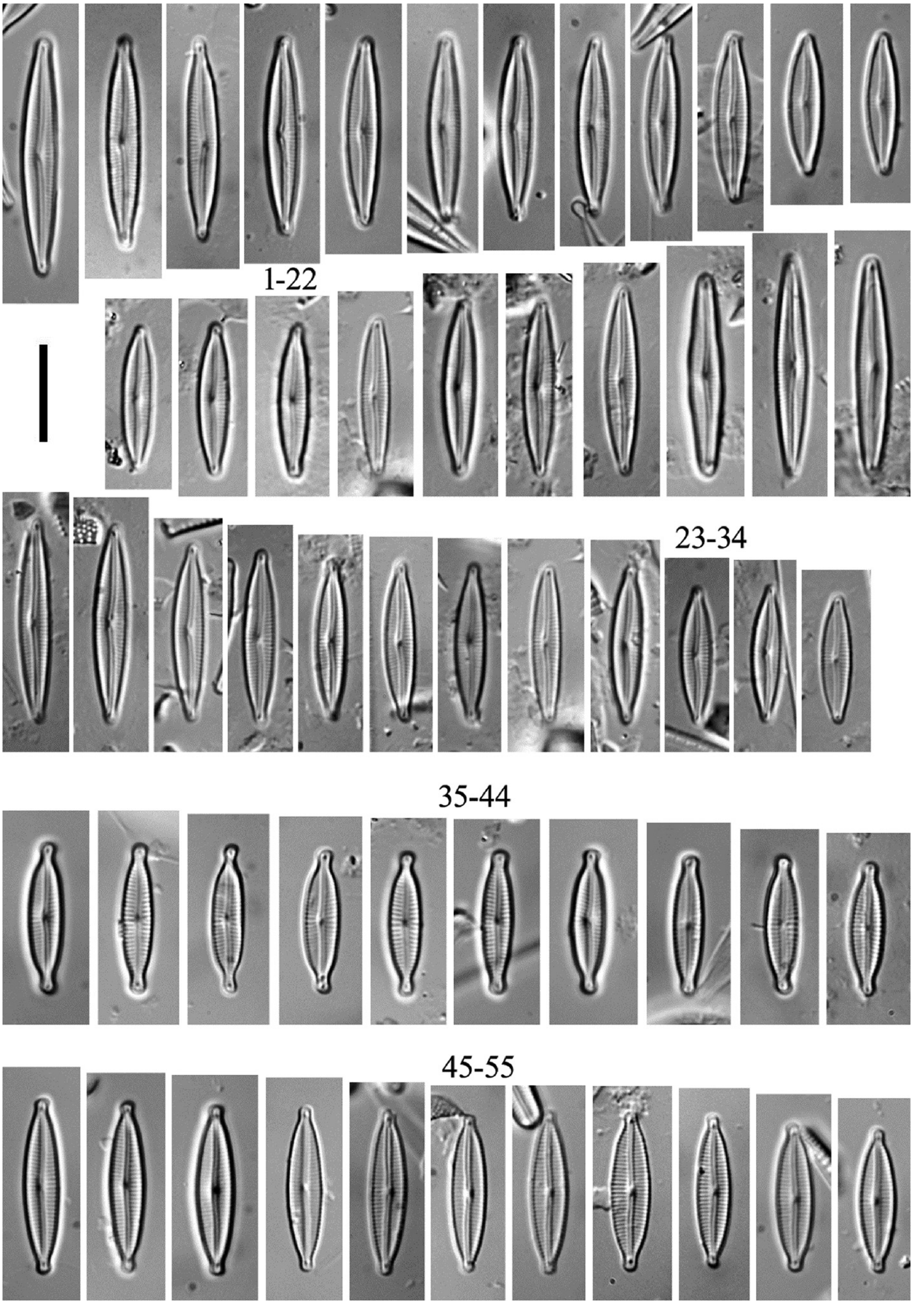

Plate 79 – *Encyonopsis krammeri* E. Reichardt (1.–34.), *Encyonopsis microcephala* (Grunow) Krammer (35.–44.), *Encyonopsis subminuta* Krammer (45.–55.).

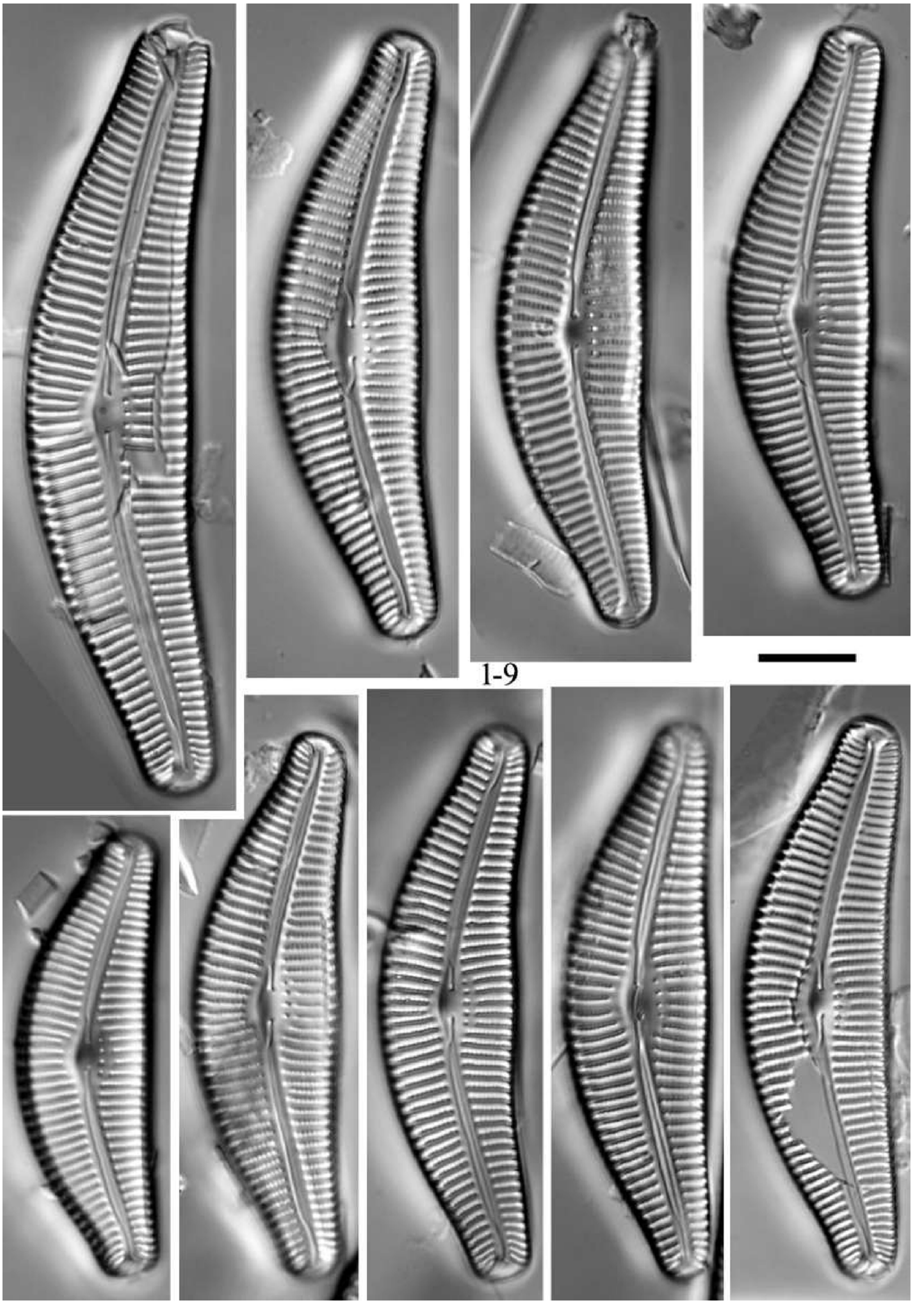

PLATE 80 – *Cymbella neocistula* Krammer (1.–9.).

PLATE 81. *Cymbella dorsenotata* Østrup

Figs 1–6. *Cymbella dorsenotata* Østrup

Valves are strongly dorsiventral, with dorsal margin strongly convex and ventral margin linear to slightly curved and tumid at mid-valve. The valve ends are rounded and slightly protracted. Valve length is 95–158 μm, valve width is 20.0–28.5 μm. The axial area is moderately wide, expanding into a large and round central area. Stigmata 6–7 are present on the ventral side of the central area. The raphe is centrally located within the axial area. The raphe is reverse lateral, the proximal raphe ends are bent ventrally and slightly expanded. Striae are slightly radiate, 6–8 in 10 μm, distinctly punctate, with 16–22 areolae in 10 μm. *Cymbella dorsenotata* is considered a widely spread (cosmopolitan) species, and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1000x

Figs 1–6. Jiuzhaigou National nature reserve, sample Acc. No. 42.

PLATE 82. *Cymbella* sp. aff. *subcistula* Krammer

Figs 1–6. *Cymbella* sp. aff. *subcistula* Krammer

Valves are strongly dorsiventral, with dorsal margin strongly convex and ventral margin linear to slightly curved and tumid at mid-valve. The valve ends are rounded and slightly protracted. Valve length is 63–93 μm, valve width is 16.0–18.5 μm. The axial area is moderately narrow, expanding into a small and round central area. Stigmata 4–6 are present on the ventral side of the central area. The raphe is centrally located within the axial area. The raphe is reverse lateral, the proximal raphe ends are bent ventrally and slightly expanded. Striae are slightly radiate, 7–9 in 10 μm, distinctly punctate, with 18–22 areolae in 10 μm.

Cymbella sp. aff. *subcistula* was recorded by Lange-Bertalot and Genkal (1999, Figs 55: 2–4) as Cymbella (nov.) spec. Probably this taxon has broader distribution in Asia, but confused with similar species from *C. subcistula* group. In the study, it was infrequently observed.

Scale bar = 10 μm
LM 1500x

Figs 1–6. Jiuzhaigou National nature reserve, sample Acc. No. 42.

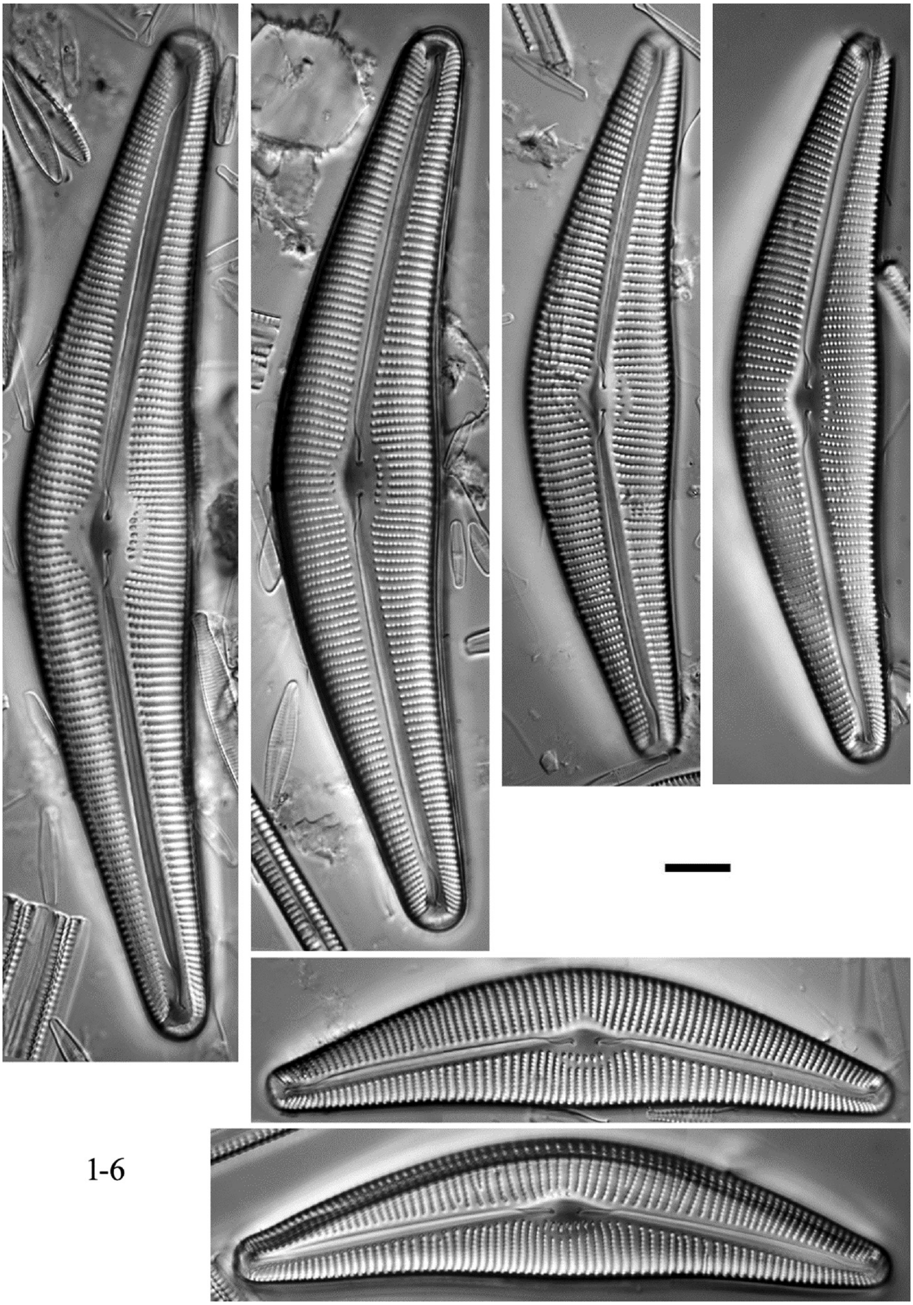

Plate 81 – *Cymbella dorsenotata* Østrup (1.–6.).

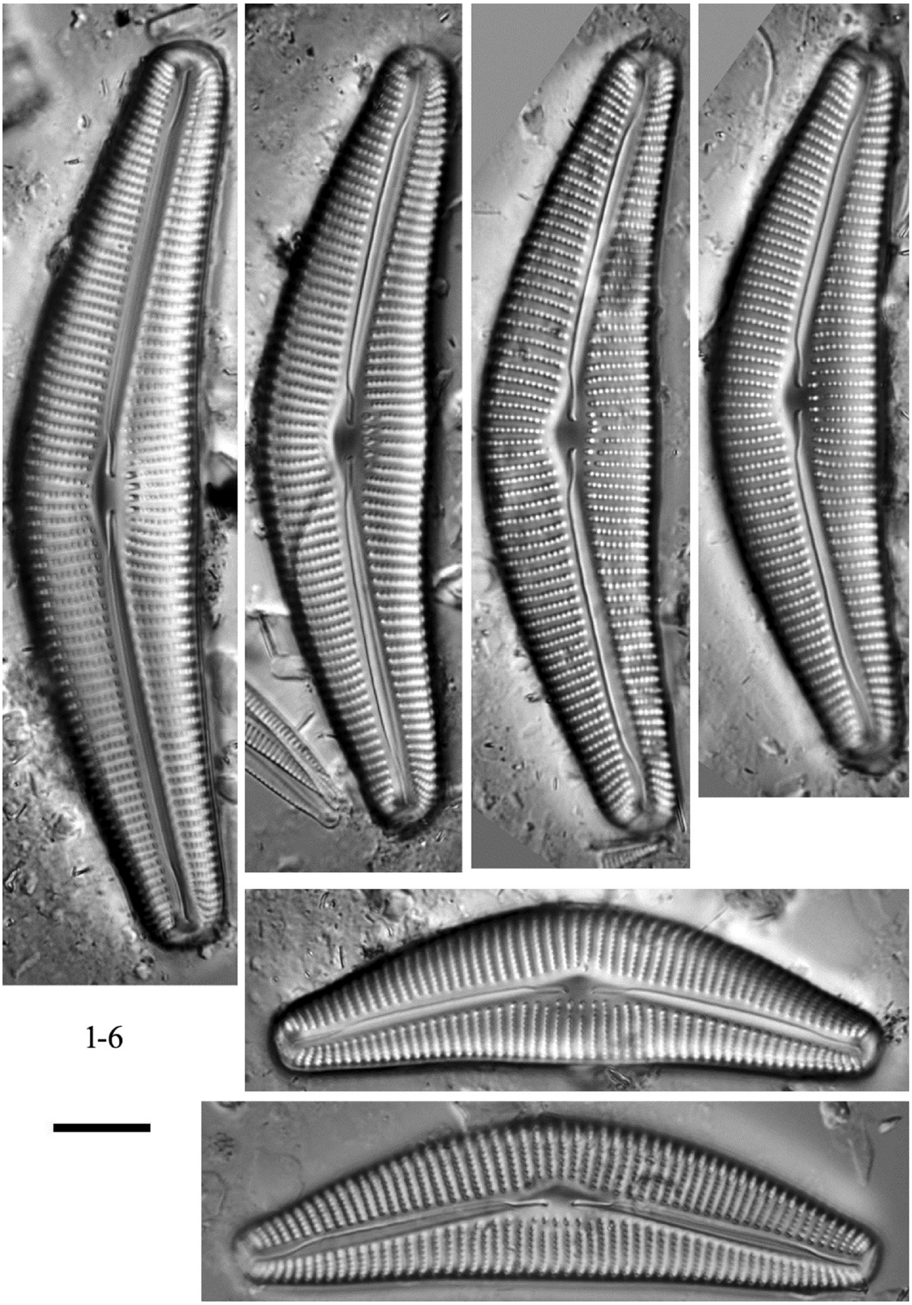

Plate 82 – *Cymbella* sp. aff. *subcistula* Krammer (1.–6.).

PLATE 83. *Cymbella asiaca* Metzeltin, Lange-Bertalot & Y. Li

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Figs 1–6. *Cymbella asiaca* Metzeltin, Lange-Bertalot & Y. Li

Valves are strongly dorsiventral, with dorsal margin strongly convex and ventral margin is linear to slightly curved and tumid at mid-valve. The valve ends are rounded and not protracted. Valve length is 73–87 μm, valve width is 16.5–20.5 μm. The axial area is moderately narrow, expanding into a large and round central area. Stigmata 4–6 are present on the ventral side of the central area. The raphe is centrally located within the axial area. The raphe is reverse lateral, the proximal raphe ends are bent ventrally and slightly expanded. Striae are slightly radiate, 6–8 in 10 μm, distinctly punctate, with 16–18 areolae in 10 μm.

Cymbella asiaca was recorded in several locations in Mongolia (Metzeltin *et al.*, 2009) and probably has broader distribution in Asia. In the study, area was infrequently observed.

Scale bar = 10 μm
LM 1500x

Figs 1–6. Jiuzhaigou National nature reserve, sample Acc. No. 11.

PLATE 84. *Cymbella stuxbergii* (Cleve) Cleve

Figs 1–4. *Cymbella stuxbergii* (Cleve) Cleve

Valves are strongly dorsiventral, with dorsal margin strongly convex and ventral margin slightly curved and tumid at mid-valve. The valve ends are rounded and not protracted. Valve length is 74–86 μm, valve width is 22.0–23.0 μm. The axial area is moderately wide, expanding into a large and round central area. Numerous stigmata (11–14) are present on the ventral side of the central area. The raphe is centrally located within the axial area. The raphe is reverse lateral, the proximal raphe ends are bent ventrally and slightly expanded. Striae are radiate, 12–14 in 10 μm, distinctly punctate, with 20–24 areolae in 10 μm.

Cymbella stuxbergii was recorded in several locations in Mongolia (Metzeltin *et al.*, 2009), P.R. China (Shi, 2013) and in the Baikal Rift Zone, Russia, and its morphological and ultrastructural characteristics were described in detail by Williams *et al.* (1999). In the study area was infrequently observed. Probably it has broader distribution in Asia.

Scale bar = 10 μm
LM 1500x

Figs 1–4. Jiuzhaigou National nature reserve, sample Bamboo Lake 3.

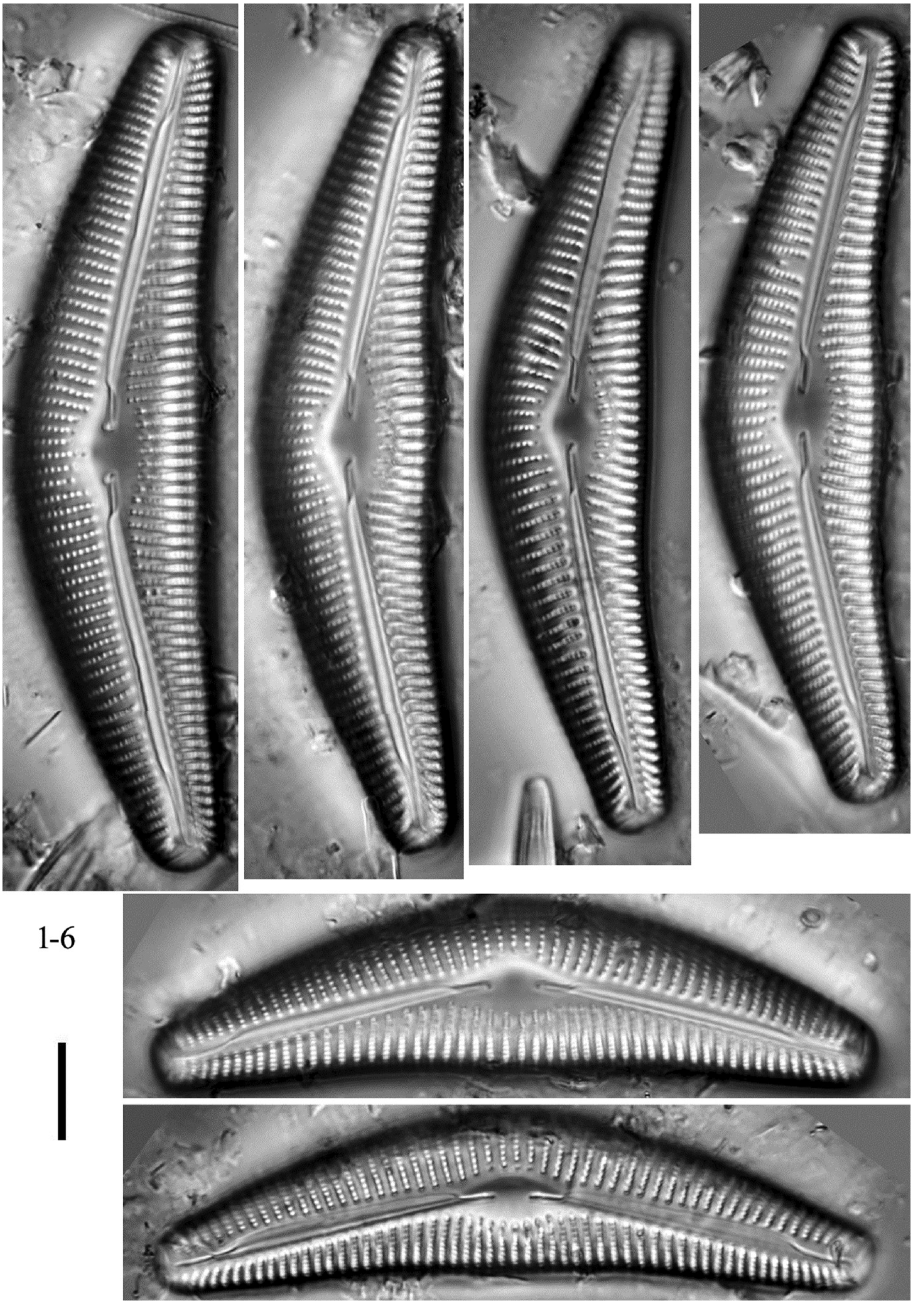

Plate 83 – *Cymbella asiaca* Metzeltin, Lange-Bertalot & Y. Li (1.–6.).

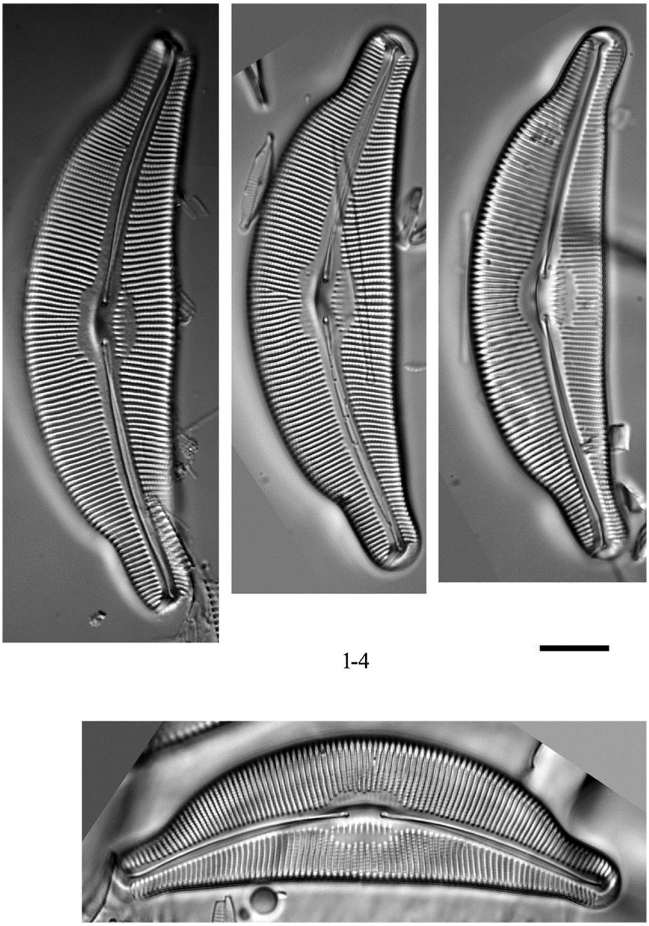

Plate 84 – *Cymbella stuxbergii* (Cleve) Cleve (1.–4.).

PLATE 85. *Cymbella rumrichae* Krammer

Figs 1–21. *Cymbella rumrichae* Krammer

Valves are strongly dorsiventral, with dorsal margin strongly convex and ventral margin slightly curved and tumid at mid-valve. The valve ends are long protracted and capitate. Valve length is 32–53 μm, valve width is 7.0–8.5 μm. The axial area is narrow, slightly expanded into a small area. A single stigma is present on the ventral side of the central area. The raphe is centrally located within the axial area. The raphe is reverse lateral, the proximal raphe ends are bent ventrally and slightly expanded. Striae are radiate, 10–12 in 10 μm, distinctly punctate, with 25–30 areolae in 10 μm. *Cymbella rumrichae* was recorded in several locations in Europe and USA, a study area was frequently observed.

Scale bar = 10 μm
LM 1500x

Figs 1–21. Jiuzhaigou National nature reserve, sample Acc. No. 42.

PLATE 86. *Cymbella hantzschiana* Krammer

Figs 1–21. *Cymbella hantzschiana* Krammer

Valves are strongly dorsiventral, with dorsal margin strongly convex and ventral margin slightly curved and tumid at mid-valve. The valve ends not protracted and broadly rounded. Valve length is 29–50 μm, valve width is 7.5–9.5 μm. The axial area is narrow, central area is not differentiated from axial area. Stigma is absent in central area. The raphe is centrally located within the axial area. The raphe is reverse lateral, the proximal raphe ends are bent ventrally and slightly expanded. Striae are radiate, 10–11 in 10 μm, distinctly punctate, with 25–30 areolae in 10 μm.

Cymbella hantzschiana is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–21. Jiuzhaigou National nature reserve, sample Acc. No. 42.

PLATE 87. *Cymbella weslawskii* Krammer

Figs 1–22. *Cymbella weslawskii* Krammer

Valves are strongly dorsiventral, with dorsal margin strongly convex and ventral margin slightly curved and tumid at mid-valve. The valve ends not protracted and broadly rounded. Valve length is 32–51 μm, valve width is 8.0–10.5 μm. The axial area is narrow, expanding into a large round central area. Stigma is absent in central area. The raphe is centrally located within the axial area. The raphe is reverse lateral, the proximal raphe ends are bent ventrally and slightly expanded. Striae are radiate, 9–11 in 10 μm, distinctly punctate, with 22–25 areolae in 10 μm.

Cymbella weslawskii is broadly distributed in Mongolia and P.R. China (Shi, 2013), and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–22. Jiuzhaigou National nature reserve, sample Acc. No. 75 – 4bH.

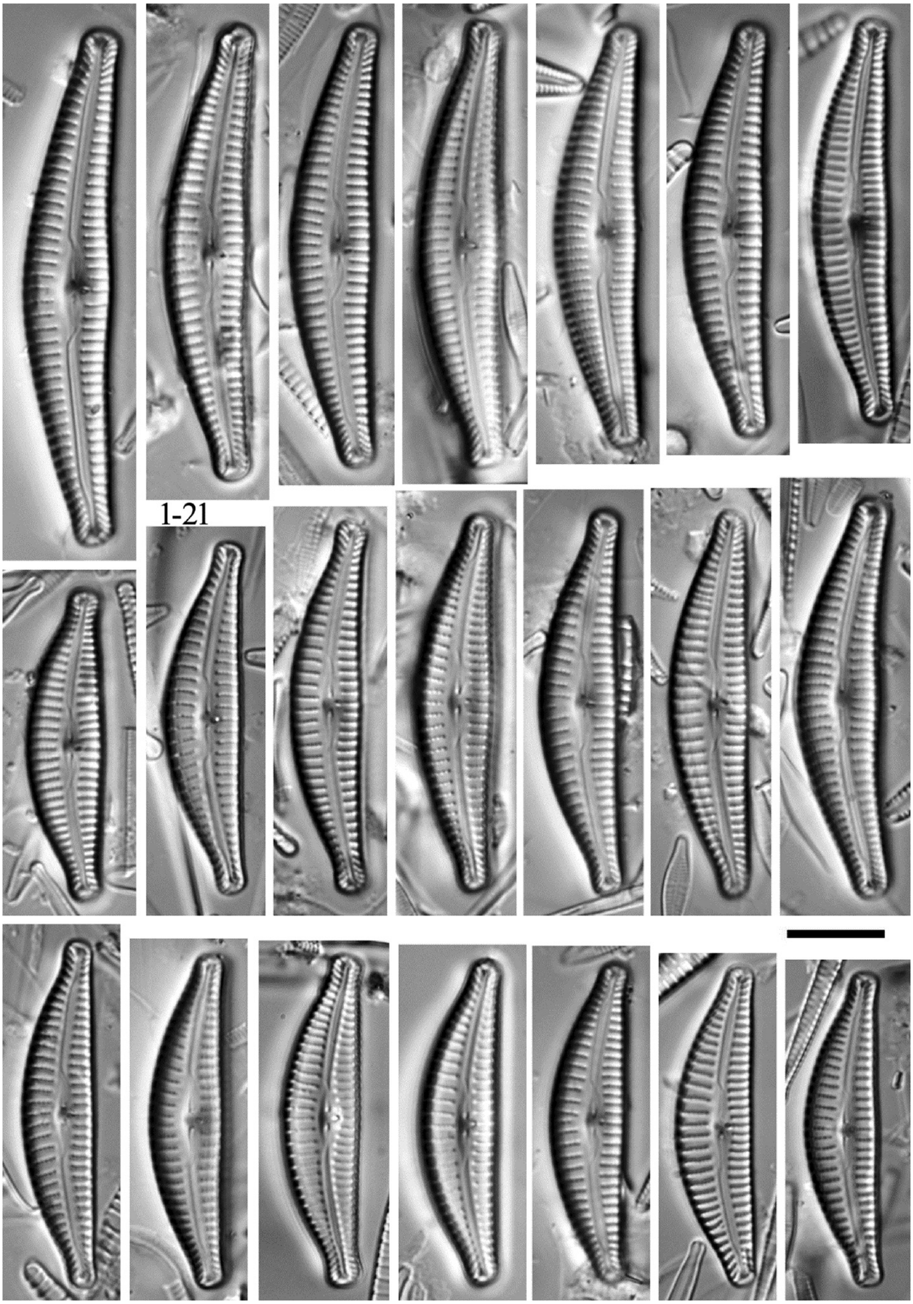

Plate 85 – *Cymbella rumrichae* Krammer (1.–4.).

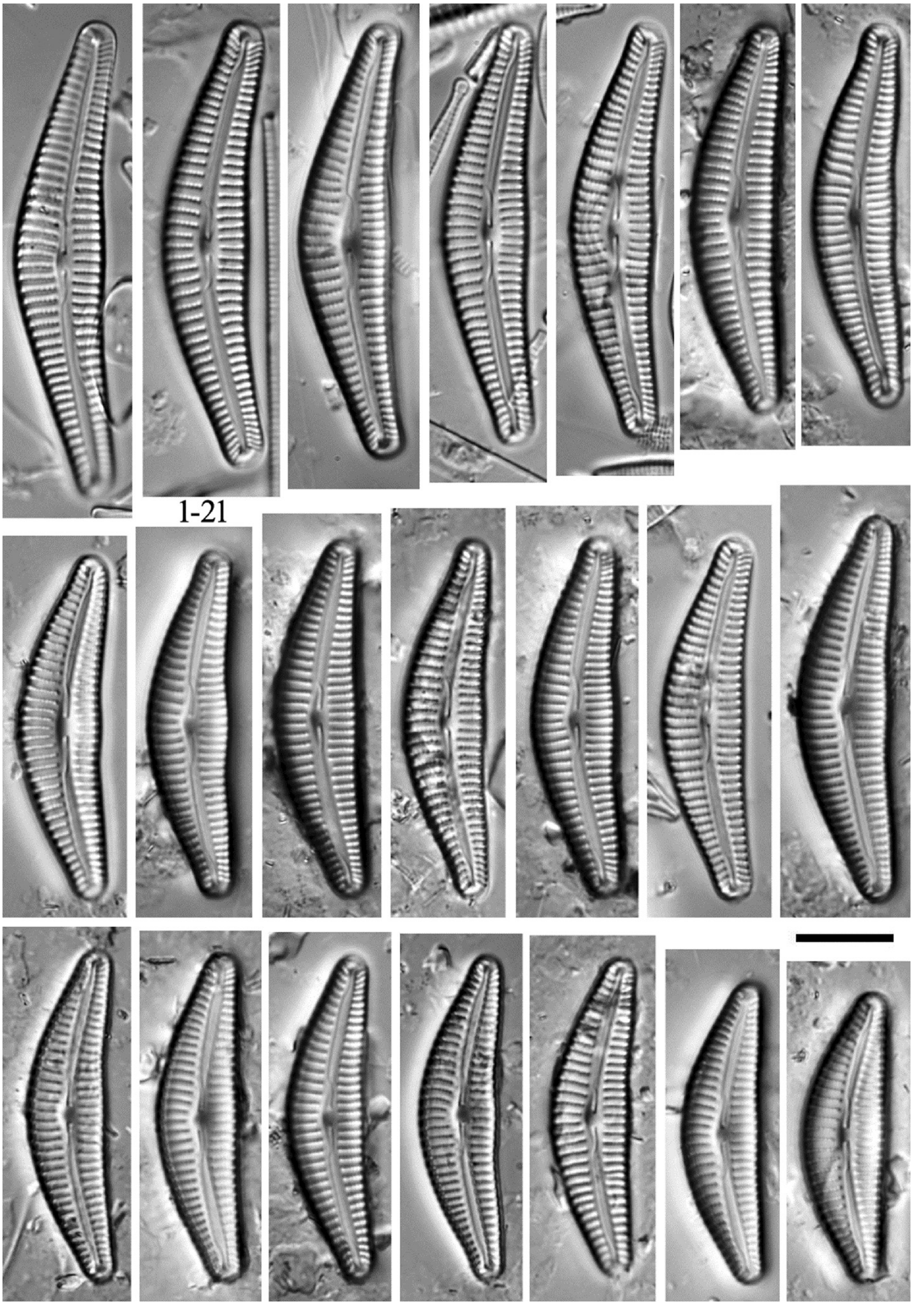

PLATE 86 – *Cymbella hantzschiana* Krammer (1.–21.).

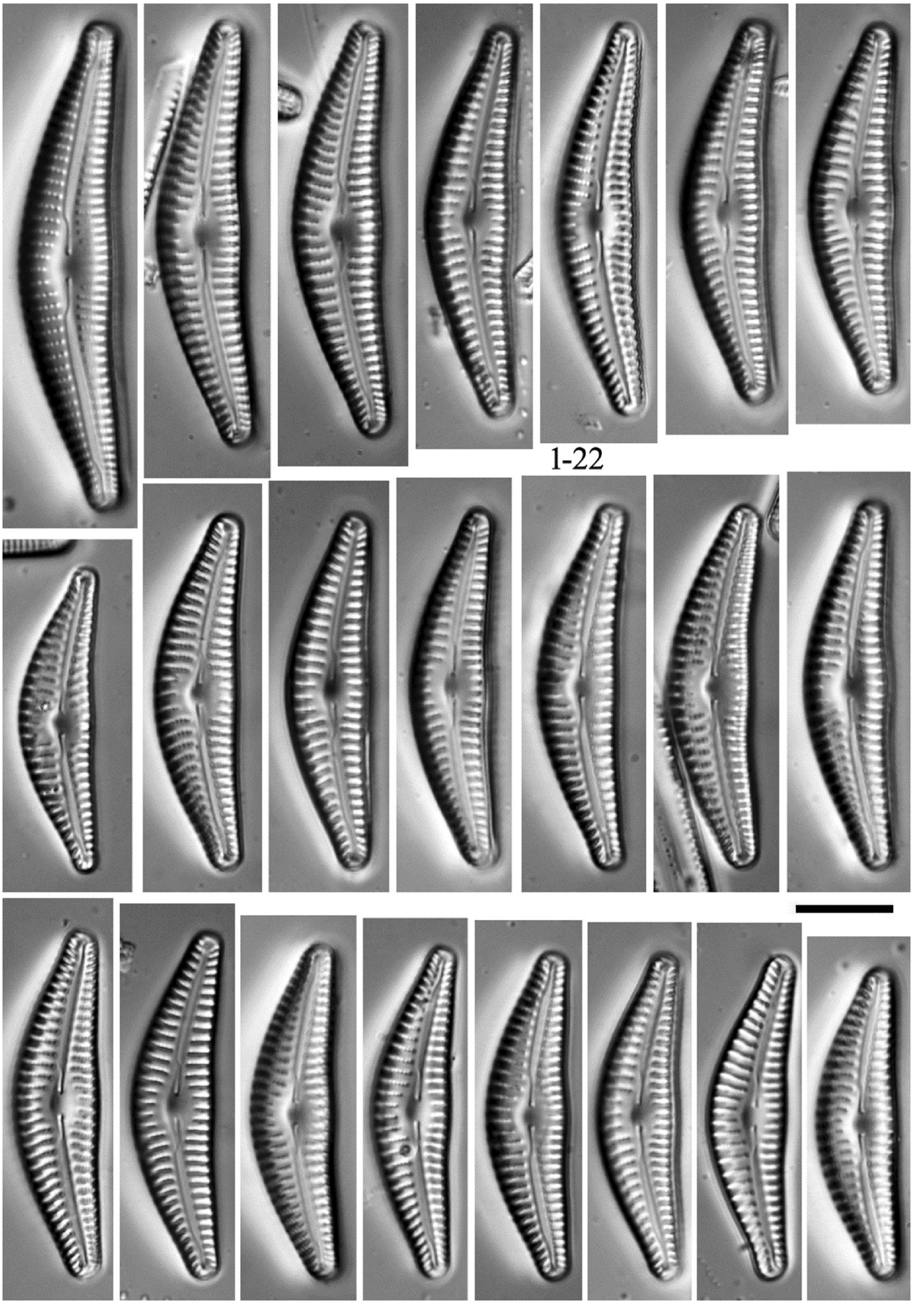

Plate 87 – *Cymbella weslawskii* Krammer (1.–22.).

PLATE 88. *Cymbella subhelvetica* Krammer

Figs 1–13. *Cymbella subhelvetica* Krammer

Valves are moderately dorsiventral, with dorsal margin strongly convex and ventral margin slightly curved and tumid at mid-valve. The valve ends not protracted and broadly rounded. Valve length is 47–70 μm, valve width is 8.0–11.5 μm. The axial area is narrow, slightly expanding into a narrow central area, more expressed from ventral side. Four to eight elongated areolae are present at the proximal ends of central ventral striae. The raphe is centrally located within the axial area. The raphe is lateral, becoming filiform towards proximal and distal ends. The proximal raphe ends are bent ventrally and slightly expanded. Striae are radiate, 9–11 in 10 μm, more densely spaced in the mid-valve from ventral side 12–13 in 10 μm, finely punctate, with 24–28 areolae in 10 μm.

Cymbella subhelvetica is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–13. Jiuzhaigou National nature reserve, sample Acc. No. 11.

PLATE 89. *Cymbella botellus* (Lagerstedt) A. Schmidt

Figs 1–39. *Cymbella botellus* (Lagerstedt) A. Schmidt

Valves are strongly to moderately dorsiventral, with dorsal margin strongly convex and ventral margin weakly concave to weakly convex. The valve ends slightly protracted to not protracted and broadly rounded. Valve length is 10–30 μm, valve width is 4.5–5.5 μm. The axial area is narrow, slightly expanding into a narrow central area, more expressed from dorsal side. 2–3 stigmata are present at the proximal ends of central ventral striae. The raphe is centrally located within the axial area. The raphe is slightly lateral, becoming filiform towards proximal and distal ends. The proximal raphe ends are bent ventrally and slightly expanded. Striae are radiate, 9–11 in 10 μm, more densely spaced in the mid-valve from ventral side 12–15 in 10 μm, finely punctate. Areolae not discernible with LM.

Cymbella botellus is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–39. Jiuzhaigou National nature reserve, sample Acc. No. 11.

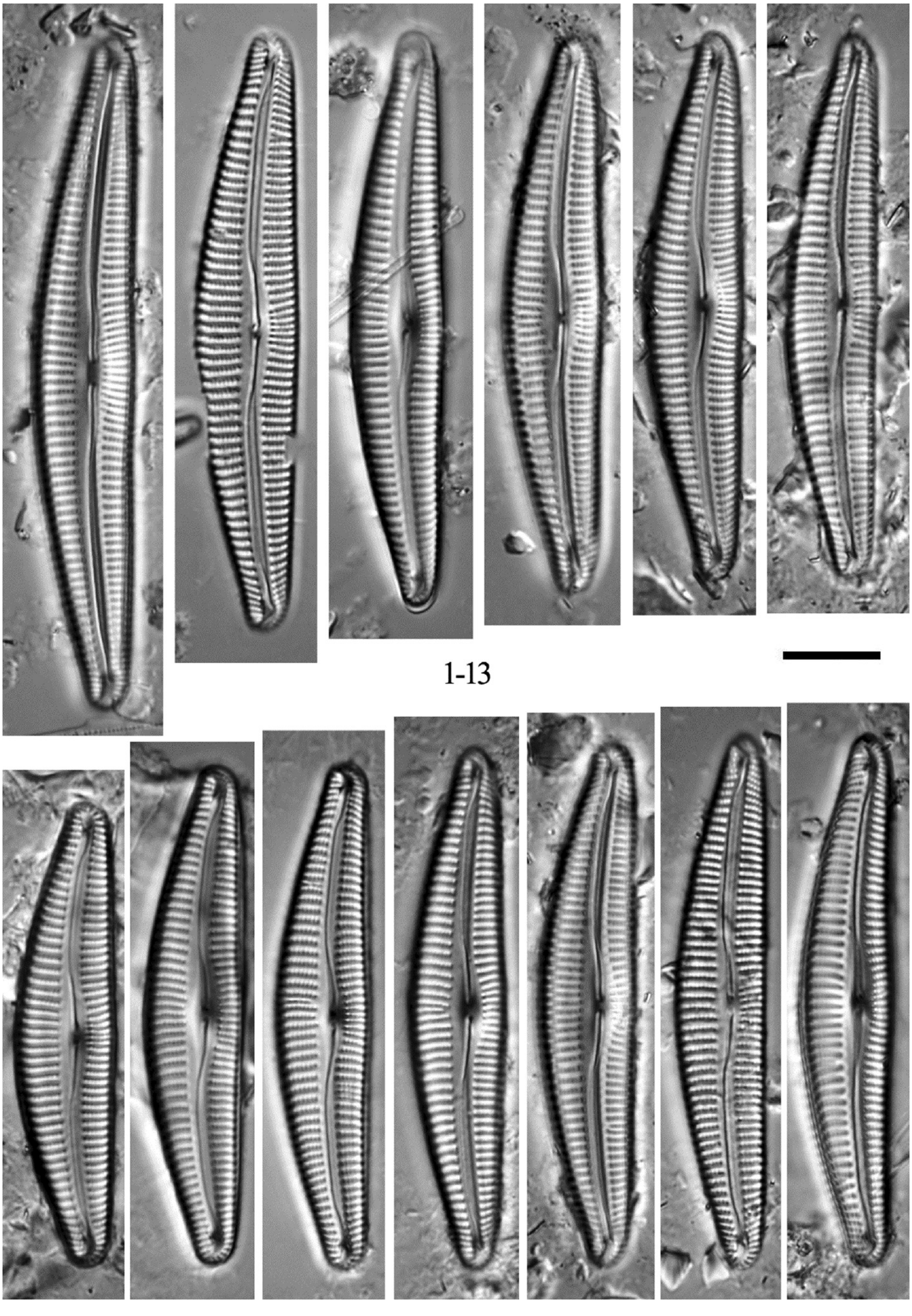

PLATE 88 – *Cymbella subhelvetica* Krammer (1.–13.).

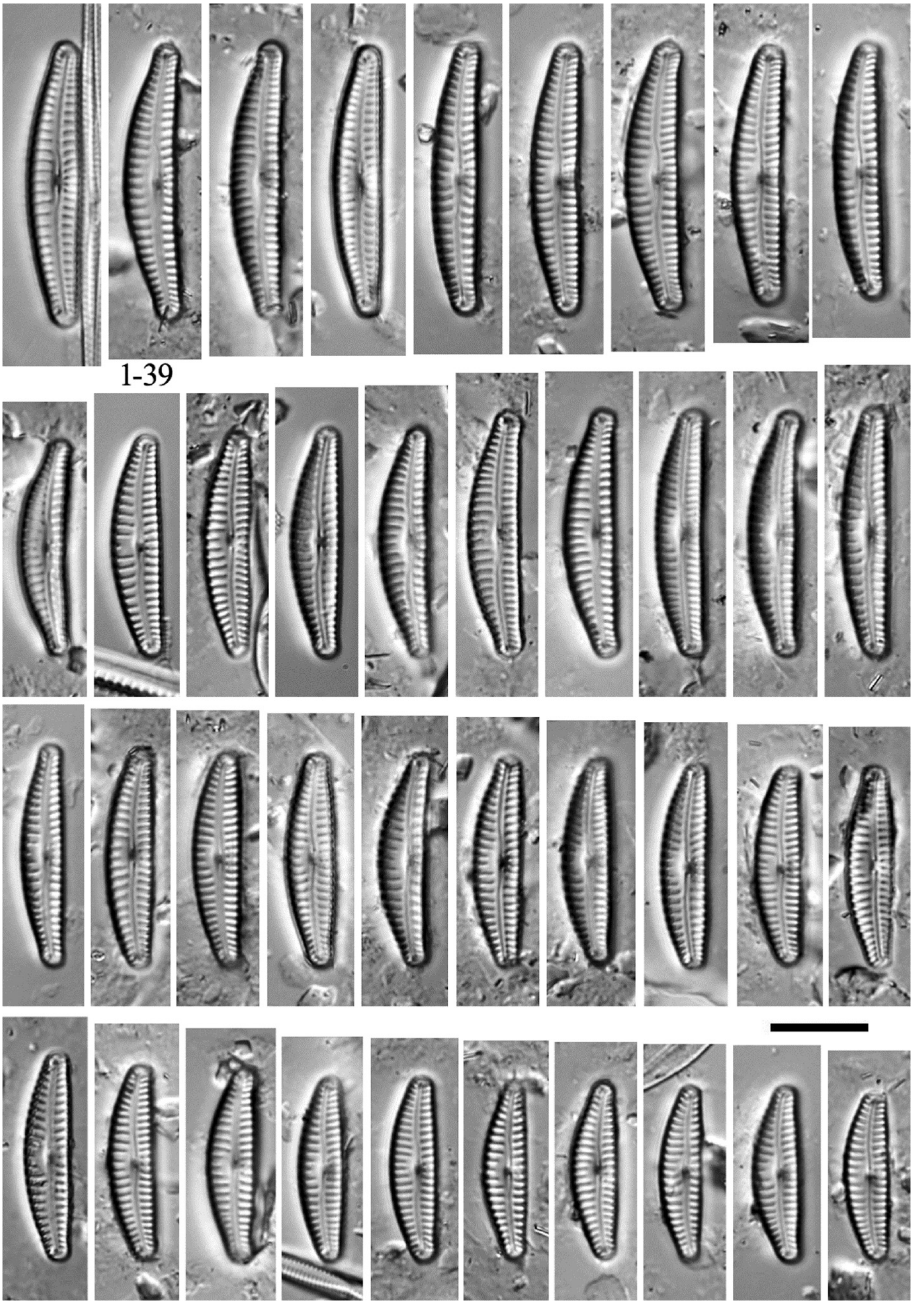

Plate 89 – *Cymbella botellus* (Lagerstedt) A. Schmidt (1.–39.).

PLATE 90. *Cymbella khokhensis* Metzeltin, Lange-Bertalot & Nergui

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Figs 1–24. *Cymbella khokhensis* Metzeltin, Lange-Bertalot & Nergui

Valves are moderately dorsiventral, lanceolate with dorsal margin convex, and ventral margin weakly convex and tumid in the middle. The valve ends not protracted to weakly protracted and broadly rounded. Valve length is 31–41 μm, valve width is 7.0–9.5 μm. The axial area is moderately narrow, slightly expanding into a narrow central area. Stigmata are absent in the central area. The raphe is centrally located within the axial area. The raphe is lateral, becoming filiform towards proximal and distal ends. The proximal raphe ends are bent ventrally and slightly expanded. Striae are radiate, 6–9 in 10 μm, coarsely punctate with 22–25 areolae in 10 μm.

Cymbella khokhensis was described from Lake Khokh, Mongolia (Metzeltin *et al.*, 2009), and probably was recorded by Li *et al.* (2008) as *Cymbella subleptoceros* Krammer. Probably this species is widely distributed in oligotrophic habitats in Asia. In the study area it was frequently observed.

Scale bar = 10 μm
LM 1500x

Figs 1–24. Jiuzhaigou National nature reserve, sample Acc. No. 71 – 5H.

PLATE 91. *Cymbella* sp. 1. nov.

Figs 1–10. *Cymbella* sp. 1. nov.

Valves are slightly dorsiventral, lanceolate with dorsal margin convex and ventral margin weakly convex and tumid in the middle. The valve ends not protracted to weakly protracted and broadly rounded. Valve length is 61–75 μm, valve width is 10.5–12.5 μm. The axial area is moderately wide, lanceolate slightly expanded near the central area. Central area is not well defined, slightly wider than axial area, wider on dorsal side. Stigmata are absent in the central area. The raphe is centrally located within the axial area. The raphe is reverse lateral. The proximal raphe ends are bent ventrally and slightly expanded. Striae are radiate, 9–11 in 10 μm, coarsely punctate with 25–28 areolae in 10 μm.

Cymbella sp. 1. based on morphological features (absence of stigmata in central area, shape of the axial and central areas, striae morphology, raphe structure) appears similar to *C. stigmaphora* but it can be differentiated by the valve shape (lanceolate and slightly dorsiventral) and valve length.

Cymbella sp. 1. was frequently observed in the samples from Jiuzhaigou National nature reserve.

The genus Cymbella is very diverse in P.R. China, and several new species recently have been described: *Cymbella hechiensis* Li & W. Zhang (in Li *et al.*, 2019), *Cymbella liyangensis* W. Zhang, I. Jüttner & E.J. Cox (in W. Zhang *et al.*, 2018a), *Cymbella pamirensis* Z.G. Zhang & Rioual (in Z.G. Zhang *et al.*, 2017) and *Cymbella xiaojinensis* Li (in Zhang *et al.*, 2021).

Scale bar = 10 μm
LM 1500x

Figs 1–10. Jiuzhaigou National nature reserve, sample Acc. No. 42.

PLATE 92. *Cymbella* sp. 2. nov.

Figs 1–23. *Cymbella* sp. 2. nov.

Valves are slightly dorsiventral, lanceolate with dorsal margin convex and ventral margin weakly convex. The valve ends not protracted to weakly protracted and broadly rounded. Valve length is 30–47 μm, valve width is 6.5–8.5 μm. The axial area is narrow linear. Central area is rectangular, unilaterally fascia from dorsal side. Stigmata are absent in the central area. The raphe is centrally located within the axial area. The raphe is reverse lateral. The proximal raphe ends are bent ventrally and slightly expanded. Striae are radiate, 10–12 in 10 μm, coarsely punctate with 25–28 areolae in 10 μm.

Cymbella sp. 2. based on morphological features looks very similar to *Cymbopleura kuelbsii* Krammer (Krammer, 2003). Li *et al.* (2008) recorded this species for the first time in P.R. China. However, LM observations reveal that this taxon very likely possesses apical pore fields on apices, thus it belongs to Cymbella, not to Cymbopleura. *Cymbopleura kuelbsii* also possess central area as unilateral fascia (semifascia) but apical pore fields are not present on apices.

Cymbella sp. 2. was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–23. Jiuzhaigou National nature reserve, sample Acc. No. 42.

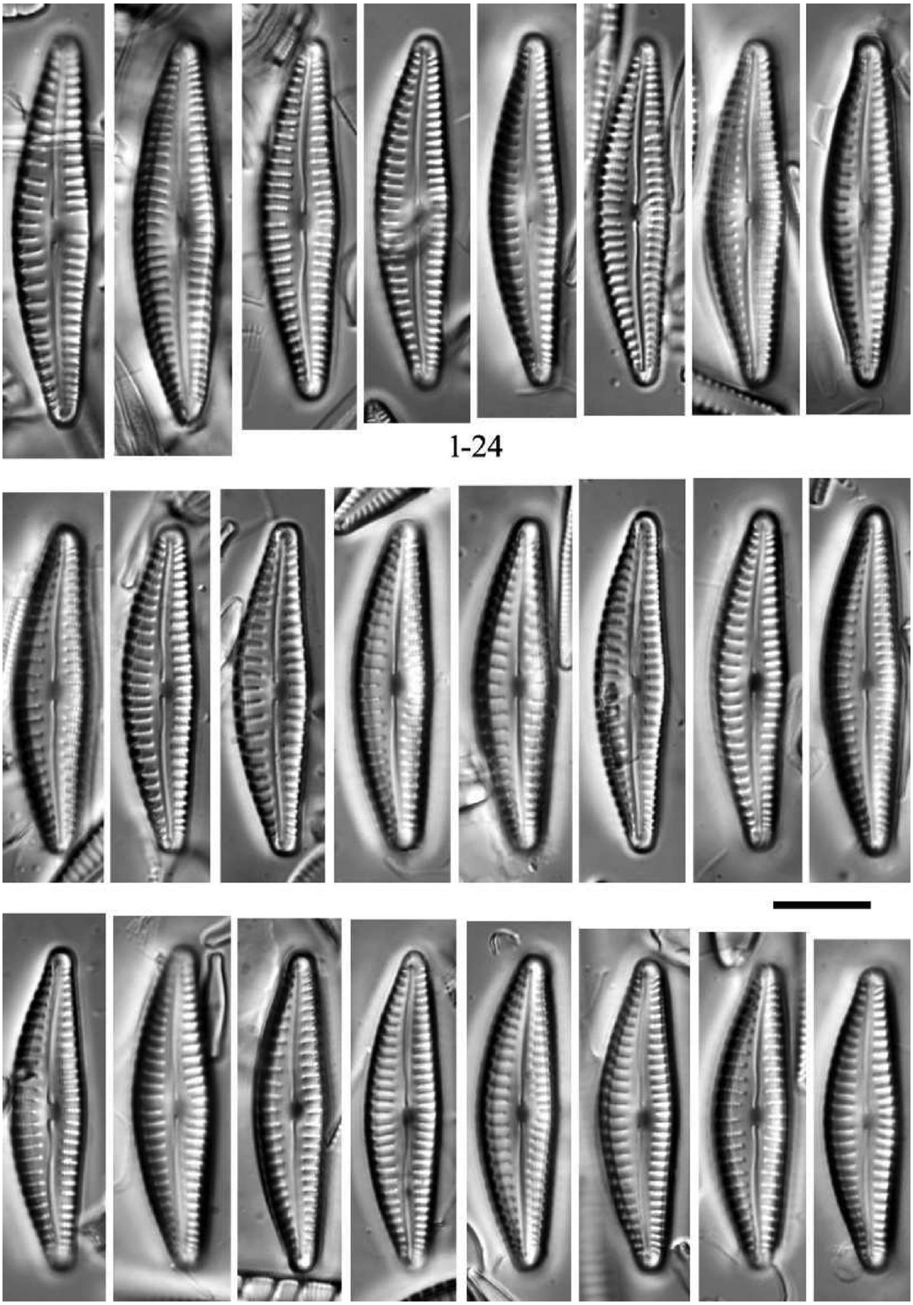

Plate 90 – *Cymbella khokhensis* Metzeltin, Lange-Bertalot & Nergui (1.–24.).

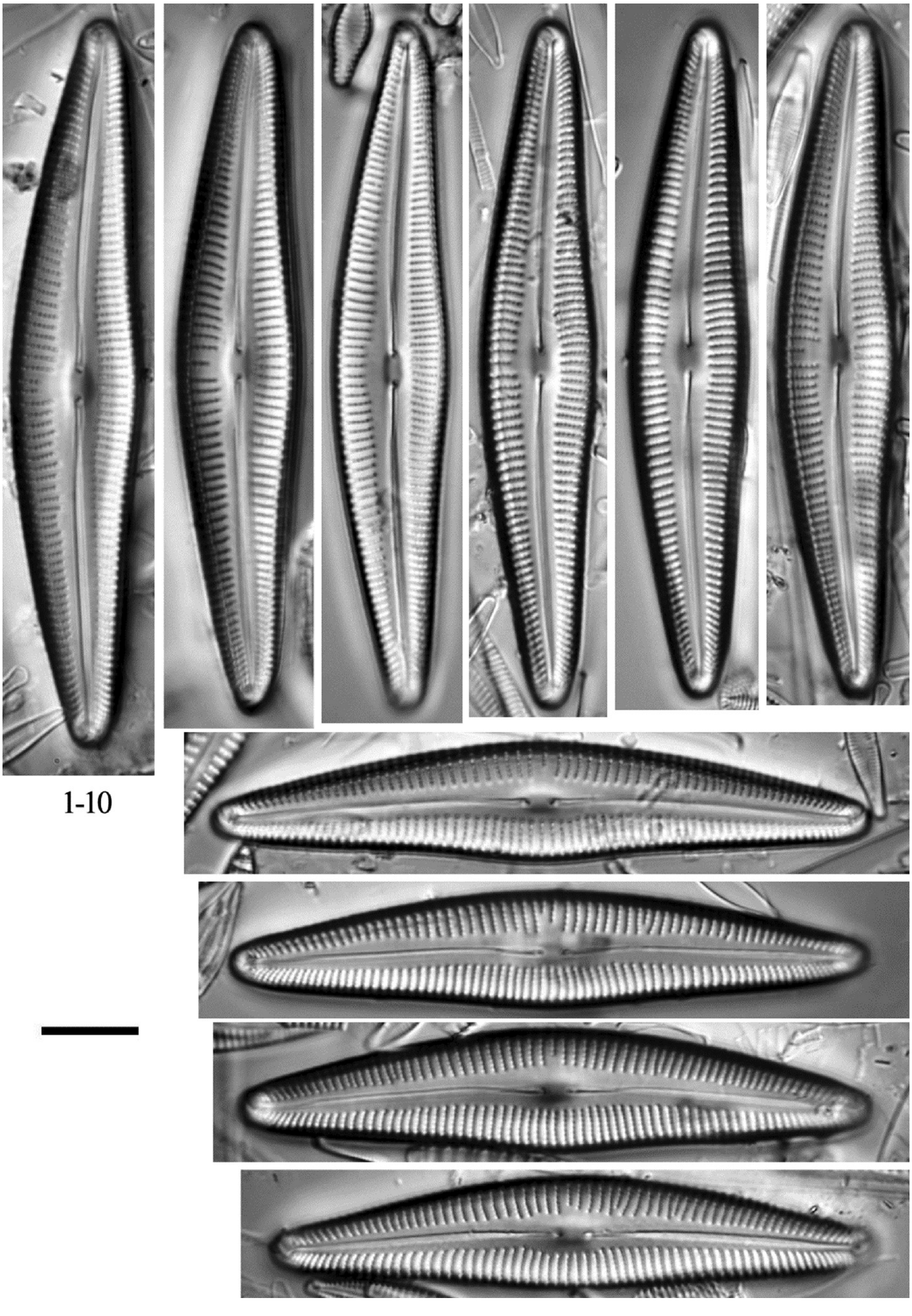

Plate 91 – *Cymbella* sp. 1. nov. (1.–10.).

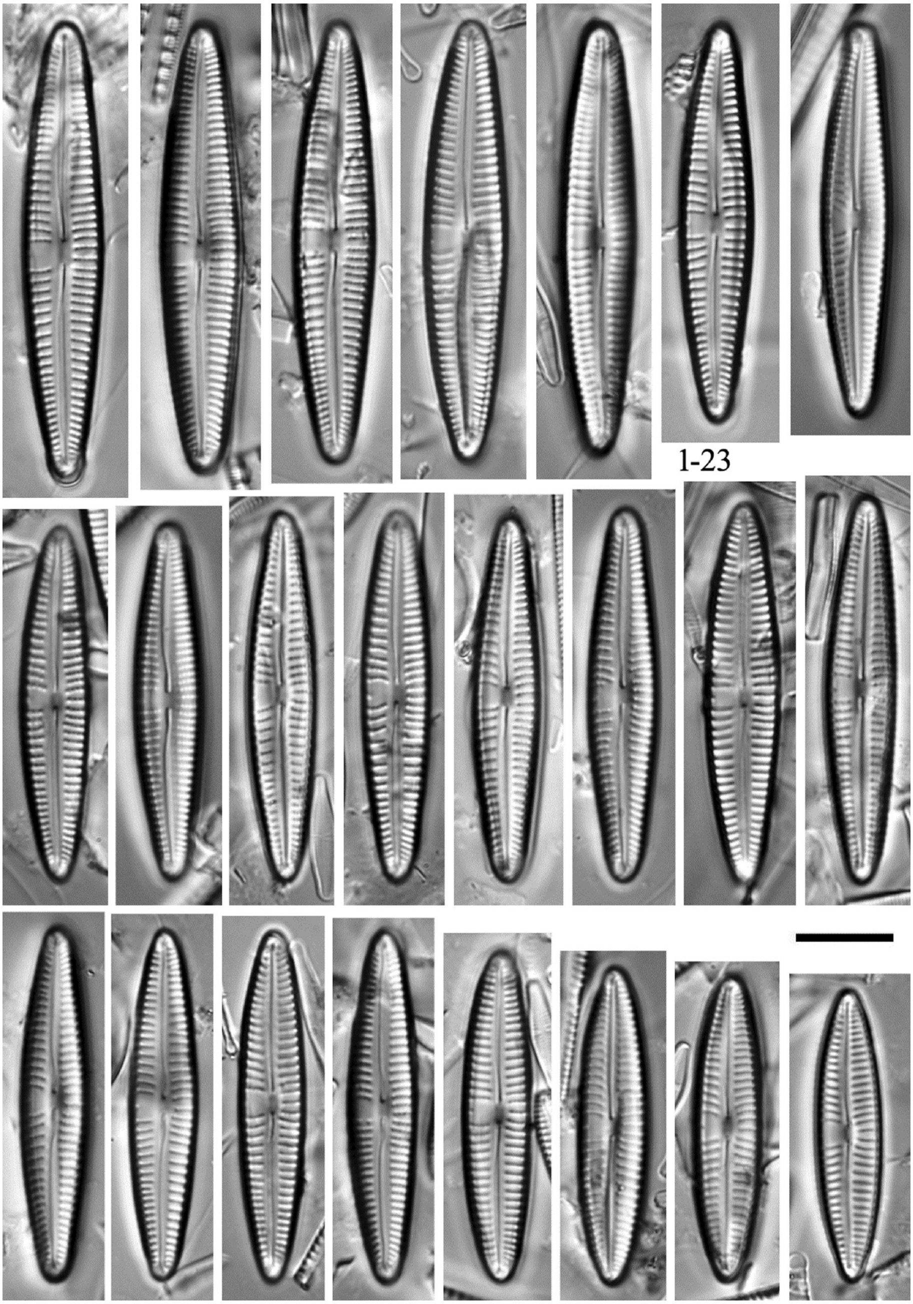

Plate 92 – *Cymbella* sp. 2. nov. (1.–23.).

PLATE 93. *Delicata sinensis* Krammer & Metzeltin

Figs 1–24. *Delicata sinensis* Krammer & Metzeltin

Valves are slightly dorsiventral, lanceolate with dorsal margin convex and ventral margin weakly convex. The valve ends slightly protracted and in some specimens slightly dorsally bent and broadly rounded. Valve length is 31–52 μm, valve width is 5.0–6.5 μm. The axial area is narrow linear. Central area is rectangular, expressed from dorsal side as rectangular semi-fascia or bordered by 2–3 distantly spaced and shortened striae. The raphe is centrally located within the axial area. The raphe is reverse lateral. The proximal raphe ends are bent ventrally and slightly expanded. Striae are radiate, 14–17 in 10 μm. Areolae are not discernible with LM.

Delicata sinensis probably is endemic species for P.R. China. It was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–24. Jiuzhaigou National nature reserve, sample Acc. No. 32.

PLATE 94. *Delicata* sp. 1. nov.

Figs 1–40. *Delicata* sp. 1. nov.

Valves are dorsiventral, semi-lanceolate with dorsal margin convex and ventral margin weakly convex. The valve ends slightly protracted and narrowly rounded. Valve length is 31–52 μm, valve width is 5.0–6.5 μm. The axial area is narrowly curved. Central area is not defined, with almost same width as axial area. The raphe branches are curved and reverse lateral. The proximal raphe ends are bent ventrally and slightly expanded. Striae are radiated, 12–18 in 10 μm. Areolae are not discernible with LM.

The genus Delicata is diverse in P.R. China and so far two species have been described: *Delicata williamsii* Liu & S. Blanco (Liu *et al.*, 2018) and *Delicata chongqingensis* Wei Zhang, S.Q. Yang & S. Blanco (in Yang *et al.*, 2019).

Delicata sp. 1. nov. probably is endemic species for P.R. China. It was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–40. Jiuzhaigou National nature reserve, sample Acc. No. 32.

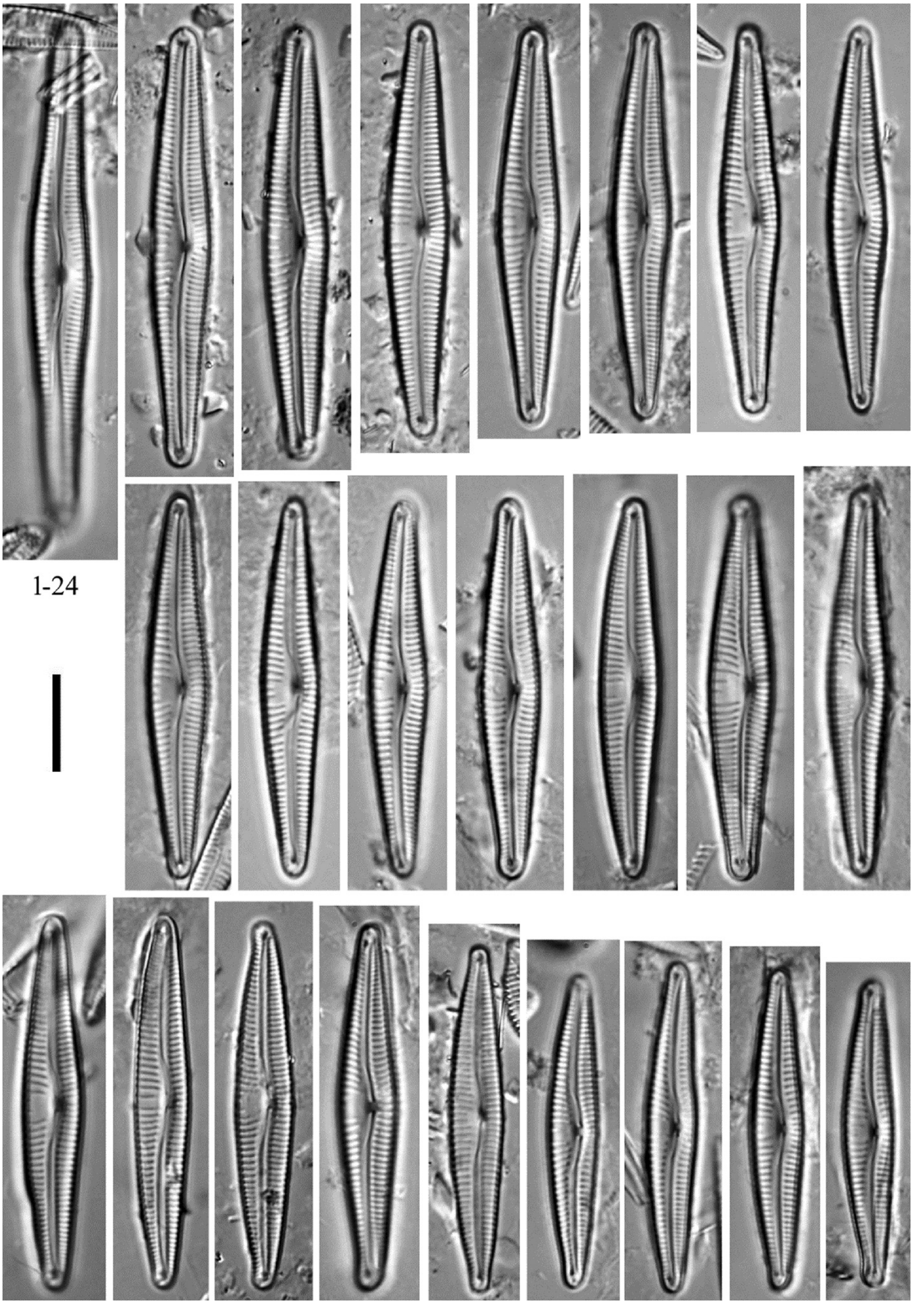

Plate 93 – *Delicata sinensis* Krammer & Metzeltin (1.–24.).

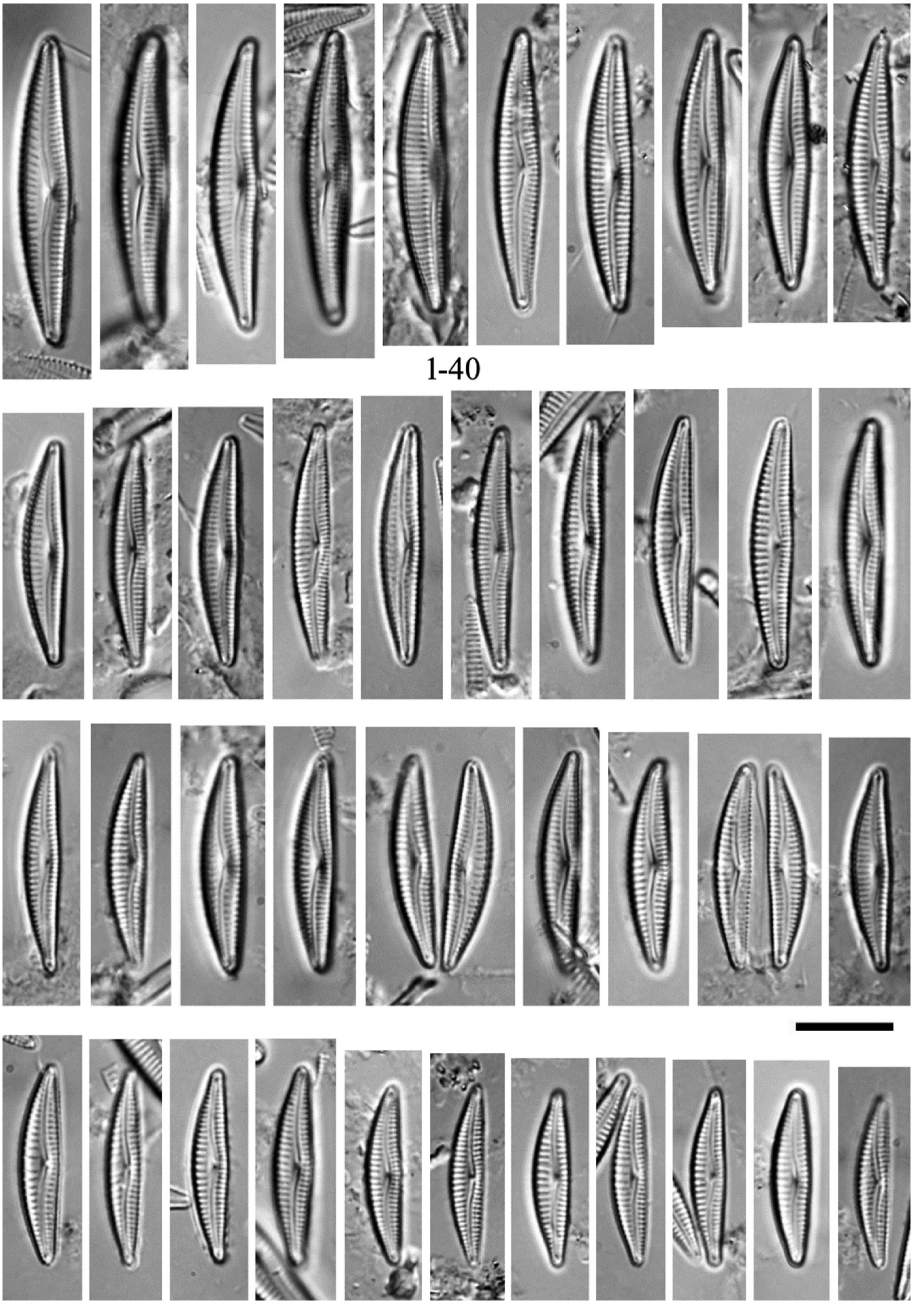

Plate 94 – *Delicata* sp. 1. nov. (1.–40.).

PLATE 95. *Cymbopleura subaequalis* (Grunow) Krammer

Figs 1–23. *Cymbopleura subaequalis* (Grunow) Krammer

Valves are lanceolate to elliptic-lanceolate and slightly dorsiventral. The dorsal margin is convex, ventral margin is weakly convex. Valve ends are obtusely rounded and subprotracted. Valve length is 26–47 μm, valve width is 7.0–9.0 μm. The axial area is narrow and slightly widened near the central area. The central area is small and irregular, slightly wider than the axial area. The raphe is lateral and narrows toward the proximal and distal ends. Proximal raphe ends are deflected ventrally and slightly expanded. Distal raphe fissures are deflected dorsally. Striae radiate throughout and indistinctly punctate, 12–16 in 10 μm.

Cymbopleura subaequalis is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–23. Jiuzhaigou National nature reserve, sample Acc. No. 70 – 2bH & 72 – 2H.

PLATE 96. *Cymbopleura oblongata* var. *parva* Krammer

Figs 1–18. *Cymbopleura oblongata* var. *parva* Krammer

Valves are linear and weakly dorsiventral. Dorsal and ventral margins are weakly convex to straight. Valve ends are obtusely rounded and subprotracted. Valve length is 32–45 μm, valve width is 6.0–8.5 μm. The axial area is narrow and slightly widened near the central area. The central area is large rectangular, more expressed on dorsal valve side. The raphe is lateral and narrows toward the proximal and distal ends. Proximal raphe ends are deflected ventrally and slightly expanded. Distal raphe fissures are deflected dorsally. Striae radiate throughout and indistinctly punctate, 10–13 in 10 μm.

Cymbopleura oblongata var. *parva* is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–18. Jiuzhaigou National nature reserve, sample Acc. No. 57 H PER1.

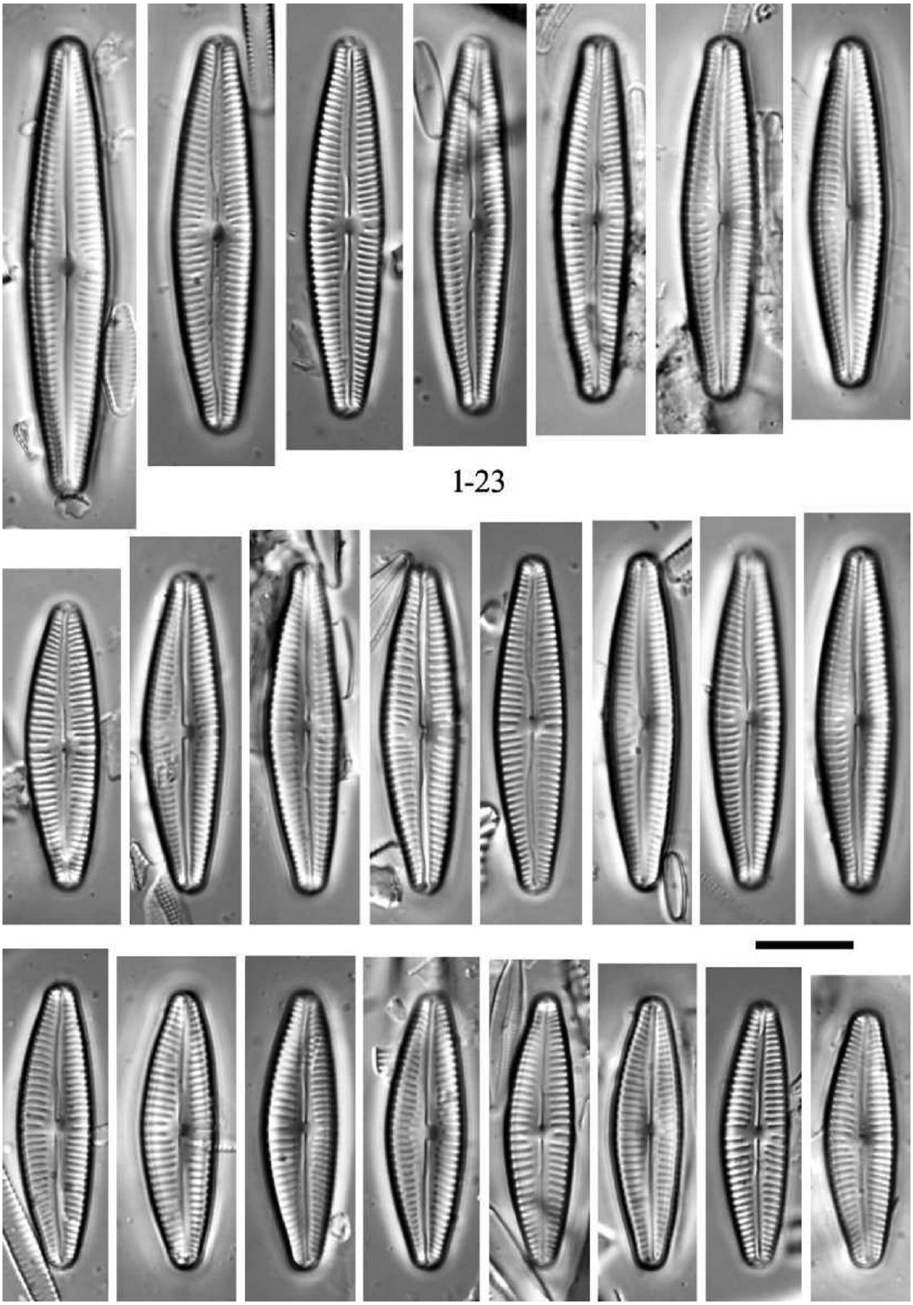

PLATE 95 – *Cymbopleura subaequalis* (Grunow) Krammer (1.–23.).

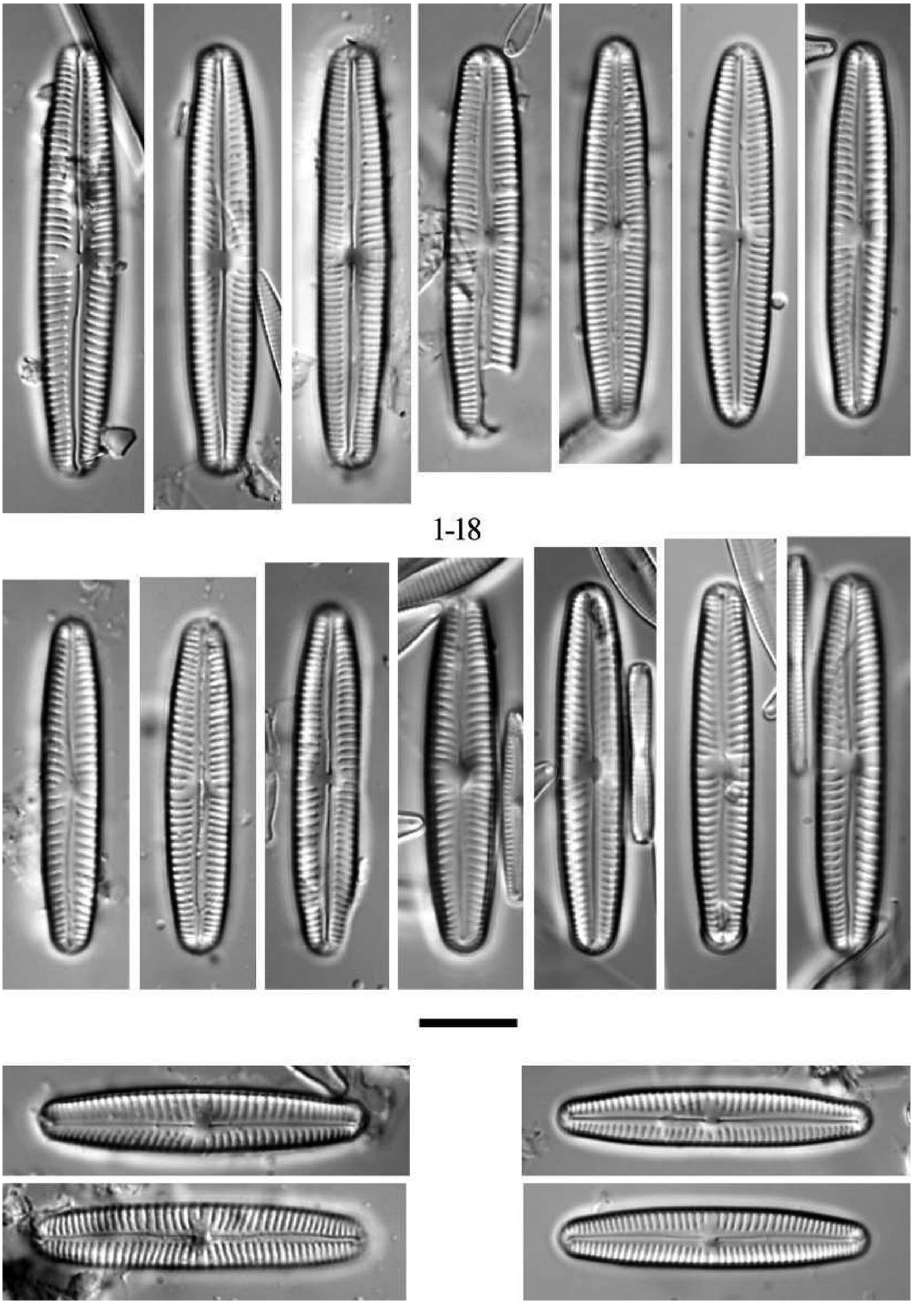

Plate 96 – *Cymbopleura oblongata* var. *parva* Krammer (1.–18.).

PLATE 97. *Cymbopleura* sp. 1. nov.

Figs 1–18. *Cymbopleura* sp. 1. nov.

Valves are lanceolate, to semi-elliptic, and weakly dorsiventral. Dorsal and ventral margins are weakly convex to straight. Valve ends are obtusely rounded and not protracted. Valve length is 27–47 μm, valve width is 7.0–8.5 μm. The axial area is narrow and slightly widened near the central area. The central area is not differentiated and slightly wider than axial area. The raphe is lateral and narrows toward the proximal and distal ends. Proximal raphe ends are deflected ventrally and slightly expanded. Distal raphe fissures are deflected dorsally. Striae radiate throughout and indistinctly punctate, 12–14 in 10 μm.

Cymbopleura sp. 1 is probably endemic to study area. In the study area it is infrequent. Larger population of this taxon has been observed in the sample Acc. No. 72 – 2H.

Scale bar = 10 μm
LM 1500x

Figs 1–18. Jiuzhaigou National nature reserve, sample Acc. No. 72 – 2H.

PLATE 98. *Cymbopleura* sp. 1. nov.

Figs 1–26. *Cymbopleura* sp. 1. nov.

Valves are lanceolate, to semi-elliptic, and weakly dorsiventral. Dorsal and ventral margins are weakly convex to straight. Valve ends are obtusely rounded and not protracted. Valve length is 27–47 μm, valve width is 7.0–8.5 μm. The axial area is narrow and slightly widened near the central area. The central area is not differentiated and slightly wider than axial area. The raphe is lateral and narrows toward the proximal and distal ends. Proximal raphe ends are deflected ventrally and slightly expanded. Distal raphe fissures are deflected dorsally. Striae radiate throughout and indistinctly punctate, 12–14 in 10 μm.

Cymbopleura sp. 1 looks similar to *Cymbopleura florentina* var. *brevis* Krammer and *C. krasskei* Krammer. This taxon was probably already recorded in P.R. China by Li *et al.* (2008) as *C. krasskei.* However, the dorsal margin is more convex compared to *C. krasskei.*

Scale bar = 10 μm
LM 1500x

Figs 1–26. Jiuzhaigou National nature reserve, sample Acc. No. 72 – 2H.

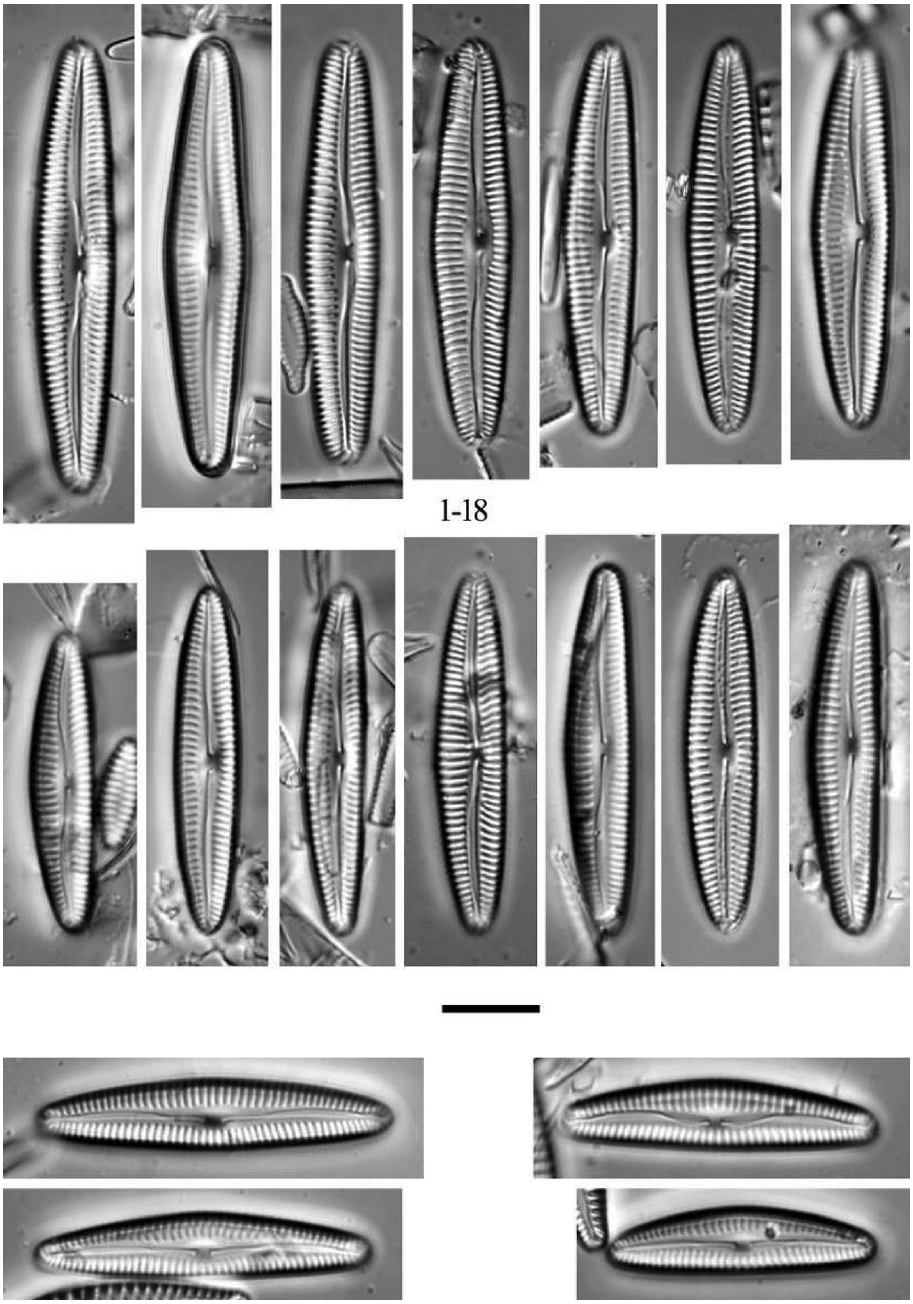

Plate 97 – *Cymbopleura* sp. 1. nov. (1.–18.).

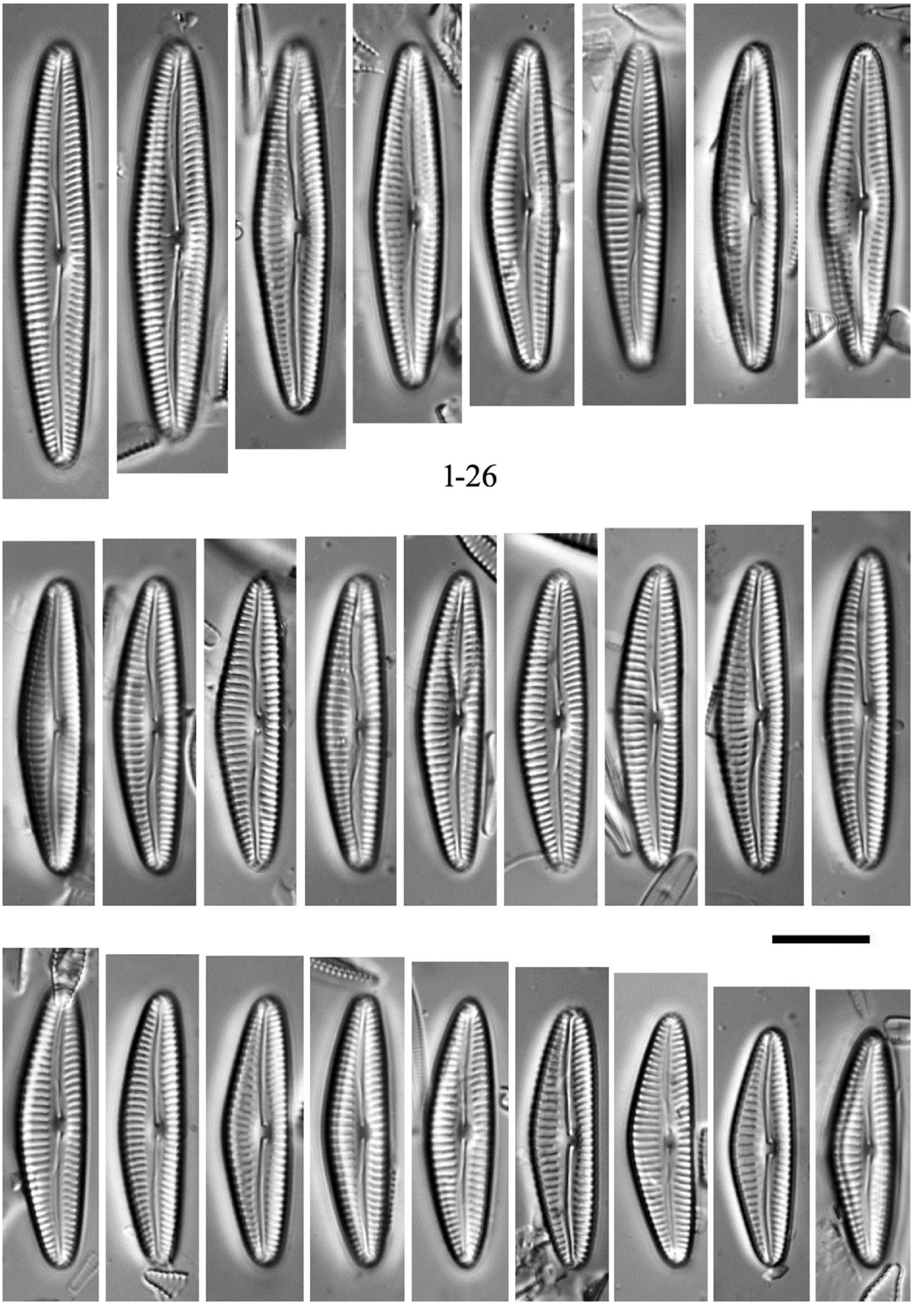

Plate 98 – *Cymbopleura* sp. 1. nov. (1.–26.).

PLATE 99. *Cymbopleura laeviformis* Krammer

Figs 1–34. *Cymbopleura laeviformis* Krammer

Valves are distinctly dorsiventral, elliptic-lanceolate to rhombic-lanceolate with narrowly rounded and not protracted apices Valve length is 27–38 μm, valve width is 7.0–9.5 μm. The axial area is narrow and slightly widened near the central area. The central area is not differentiated and slightly wider than axial area. The raphe is lateral and narrows toward the proximal and distal ends. Proximal raphe ends are deflected ventrally and slightly expanded. Distal raphe fissures are deflected dorsally. Striae radiate throughout and indistinctly punctate, 11–13 in 10 μm.

Cymbopleura laeviformis is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–34. Jiuzhaigou National nature reserve, sample Acc. No. 9.

PLATE 100. *Cymbopleura rupicola* (Grunow) Krammer, *Cymbopleura lata* (Grunow) Krammer

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Figs 1–20. *Cymbopleura rupicola* (Grunow) Krammer

Valves are slightly dorsiventral, lanceolate to rhombic-lanceolate with narrowly rounded and slightly protracted apices Valve length is 35–41 μm, valve width is 6.5–8.0 μm. The axial area is narrow, linear, and in some specimens lanceolate and slightly widened near the central area. The central area is not differentiated and slightly wider than axial area. The raphe is reverse lateral. Proximal raphe ends are deflected ventrally and slightly expanded. Distal raphe fissures are deflected dorsally. Striae radiate throughout and indistinctly punctate, 12–14 in 10 μm.

Cymbopleura rupicola observed in this study slightly differs from populations from Europe (Krammer, 2003, figs 66: 1–17) by the valve shape (more lanceolate than rhombic-lanceolate), but other features fit the description provided by Krammer (2003). *Cymbopleura rupicola* is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Fig. 21. *Cymbopleura lata* (Grunow) Krammer

Scale bar = 10 μm
LM 1500x

Figs 1–21. Jiuzhaigou National nature reserve, sample Acc. No. 11.

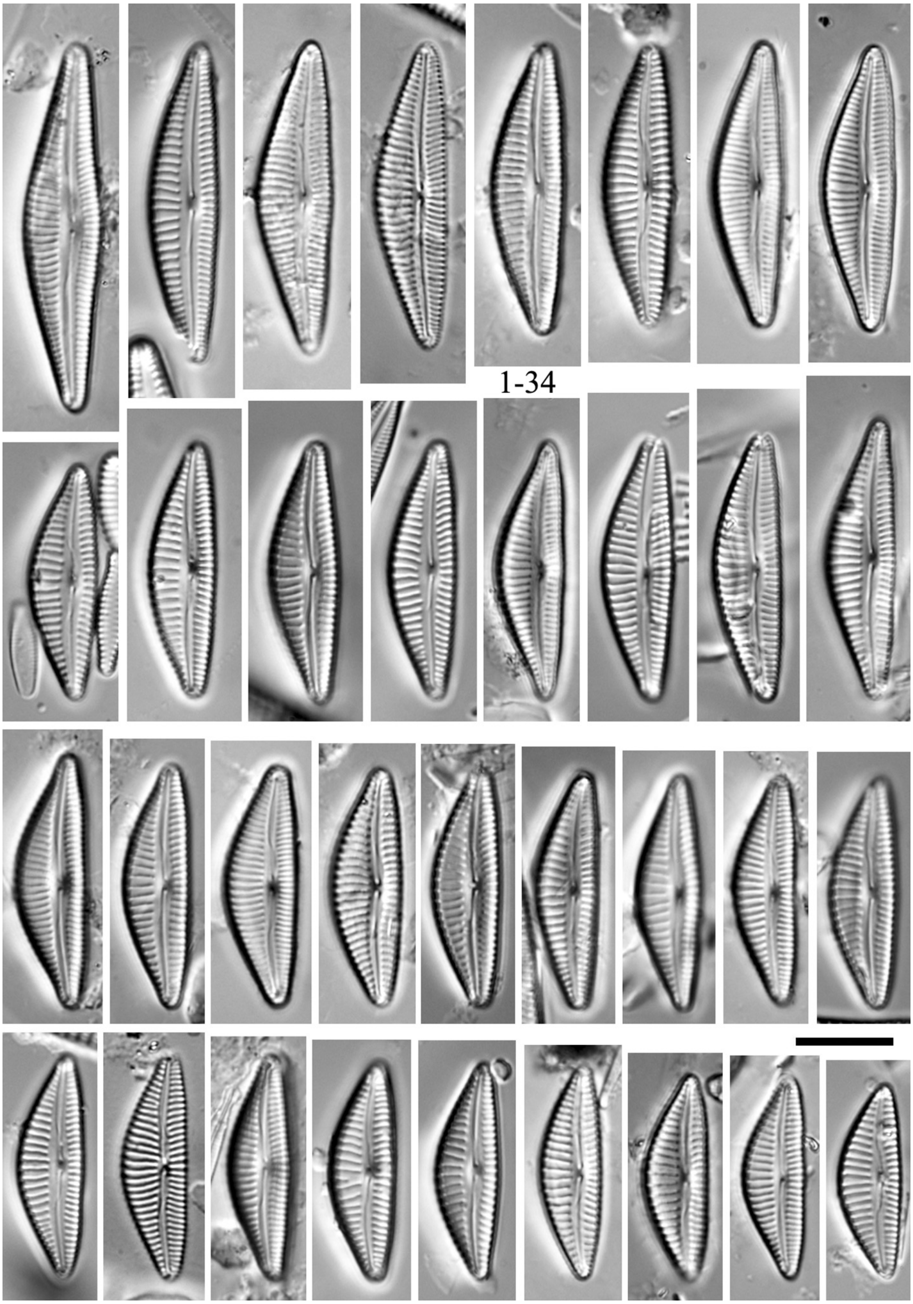

Plate 99 – *Cymbopleura laeviformis* Krammer (1.–34.).

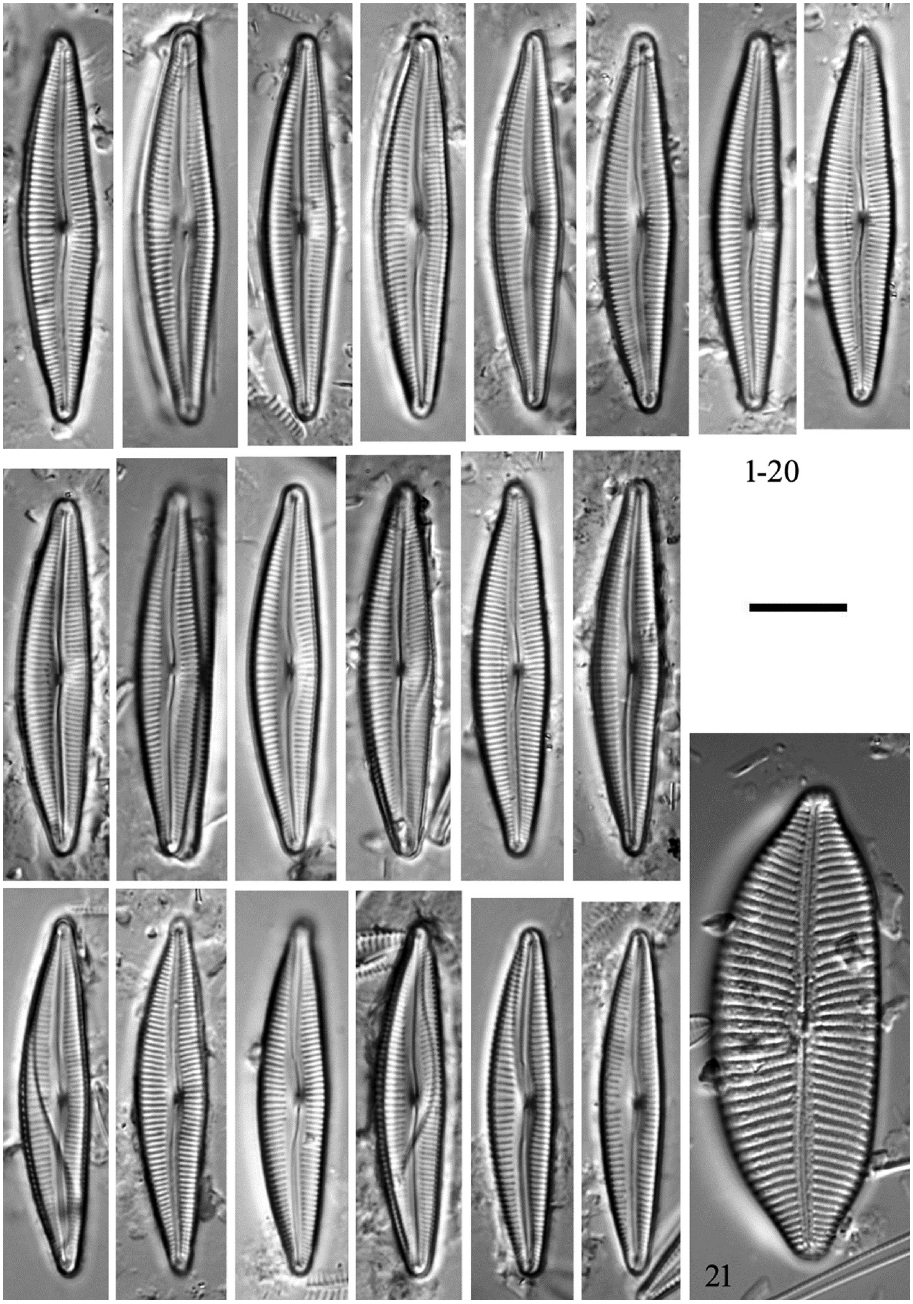

Plate 100 – *Cymbopleura rupicola* (Grunow) Krammer (1.–20.), *Cymbopleura lata* (Grunow) Krammer (21.).

PLATE 101. *Cymbopleura* sp. 2. nov., *Delicata williamsii* B. Liu & S. Blanco

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Figs 1–11. *Cymbopleura* sp. 2. nov.

Valves are slightly dorsiventral, narrowly lanceolate with weakly protracted and broadly rounded apices Valve length is 34–54 μm, valve width is 7.0–8.5 μm. The axial area is narrow, linear, and slightly widened near the central area. The central area is not differentiated and slightly wider than axial area. The raphe is lateral becoming filiform towards ends. Proximal raphe ends are deflected ventrally and slightly expanded. Distal raphe fissures are deflected dorsally. Striae radiate throughout and indistinctly punctate, 16–18 in 10 μm.

Cymbopleura sp. 2 appears similar to C. rupicola with respect to the valve size, axial and central areas, but can be differentiated valve shape and stria density. In the study area *Cymbopleura* sp. 2 was rarely observed.

Figs 12–25. *Delicata williamsii* B. Liu & S. Blanco

Valves are lanceolate, to rhombic-lanceolate, and weakly dorsiventral. Dorsal and ventral margins are weakly convex. Valve ends are slightly or not protracted and narrowly rounded. Valve length is 24–40 μm, valve width is 4.5–5.5 μm. The axial area is narrow, curved, and slightly widened near the central area. The central area is variable, not differentiated, and slightly wider then axial area to asymmetric and wider on dorsal side. Two central striae usually more distantly spaced. The raphe is lateral and narrows toward the proximal and distal ends. Proximal raphe ends are deflected ventrally and slightly expanded. Distal raphe fissures are deflected dorsally. Striae radiate throughout and indistinctly punctate, 14–16 in 10 μm.

*Delicata williams*ii is probably endemic for P.R. China, although Liu *et al.* (2018) observed it only from type locality, river course near Jinlong power station Wudaoshui Town close to Badagongshan National Nature Reserve, Hunan Province, P.R. China.

Scale bar = 10 μm
LM 1500x

Figs 1–25. Jiuzhaigou National nature reserve, sample Acc. No. 32 – 3J.

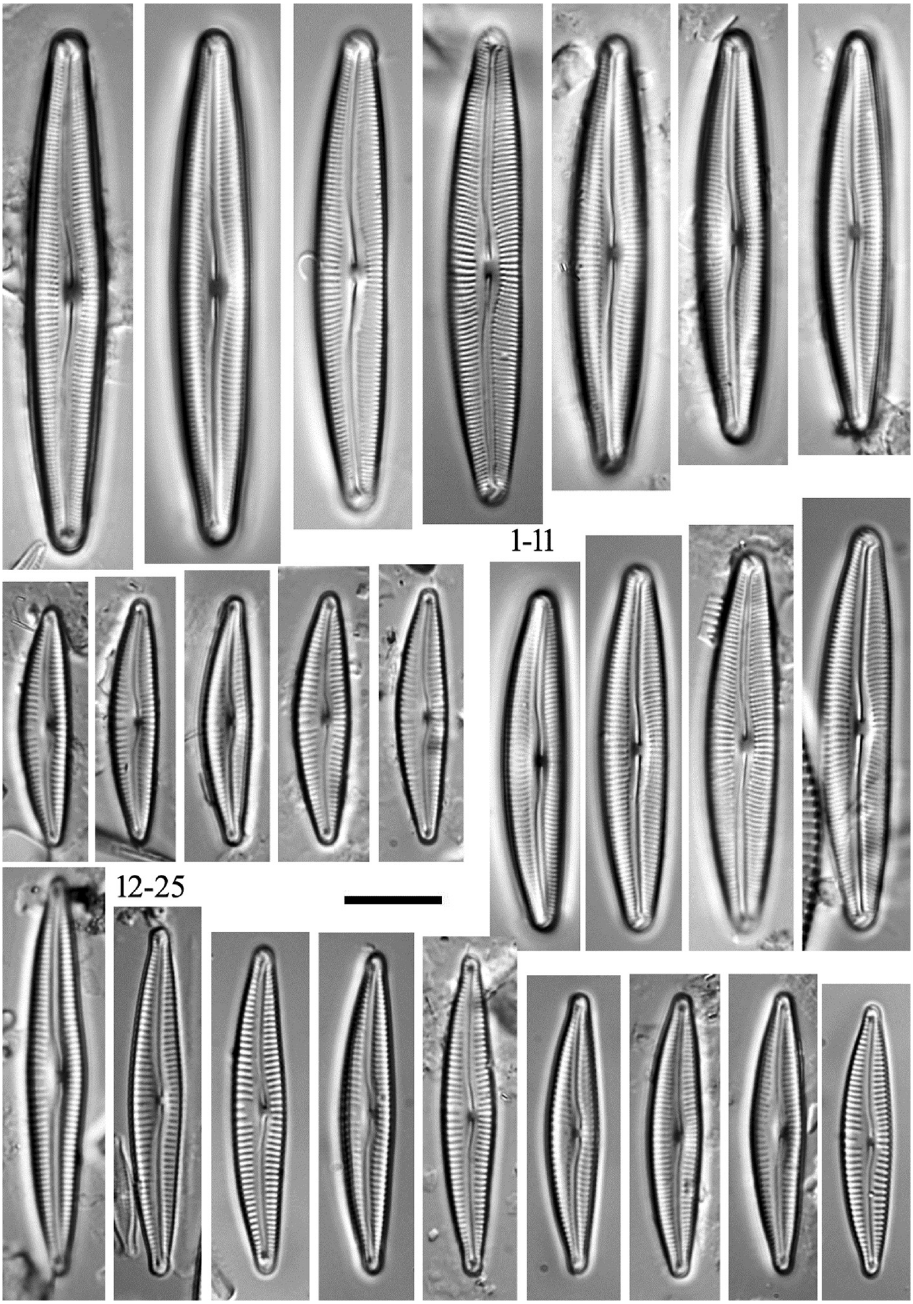

Plate 101 – *Cymbopleura* sp. 2. nov. (1.–11.), *Delicata williamsii* B. Liu & S. Blanco (12.–25.).

PLATE 102. *Cymbopleura* sp. 3. nov.

Figs 1–20. *Cymbopleura* sp. 3. nov.

Valves are slightly dorsiventral, lanceolate with weakly protracted and narrowly rounded apices. Post-initial cells slightly tumid in the mid-valve. Valve length is 32–56 μm, valve width is 7.0–8.5 μm. The axial area is narrow, linear, and slightly widened near the central area. The central area is variable, not differentiated and slightly wider than axial area to transversally elliptical. In some specimens, central striae might be more distantly spaced. The raphe is lateral becoming reverse lateral towards proximal ends. Proximal raphe ends are deflected ventrally and slightly expanded. Distal raphe fissures are deflected dorsally. Striae radiate throughout and indistinctly punctate, 14–16 in 10 μm.

Cymbopleura sp. 3. nov. probably is endemic species for P.R. China and so far it was observed from Jiuzhaigou National nature reserve where it is abundant in several samples.

Scale bar = 10 μm
LM 1500x

Figs 1–20. Jiuzhaigou National nature reserve, sample Acc. No. 41 JG PP1.

PLATE 103. *Cymbopleura* aff. *lapponica* (Grunow) Krammer

Figs 1–23. *Cymbopleura* aff. *lapponica* (Grunow) Krammer

Valves are slightly dorsiventral, lanceolate with dorsal margin convex and ventral margin slightly convex. Valve ends are narrowly protracted to subcapitate. Valve length is 30–43 μm, valve width is 6.5–8.0 μm. The axial area is narrow, linear, and slightly widened near the central area. The central area is wide, usually broader on dorsal side, rectangular to round. In some specimens, central striae might be more distantly spaced. The raphe is lateral becoming filiform towards proximal ends. Proximal raphe ends are deflected ventrally and slightly expanded. Distal raphe fissures are deflected dorsally. Striae radiate throughout and indistinctly punctate, 16–17 in 10 μm.

Cymbopleura aff. *lapponica* closely resembles *C. lapponica* and with respect to the valve size, shape, and stria density. Differences can be noticed in the shape of the central area, whereas *C. lapponica* is round compared to rectangular central area in this taxon.

Scale bar = 10 μm
LM 1500x

Figs 1–23. Jiuzhaigou National nature reserve, sample Acc. No. 67 1Ah.

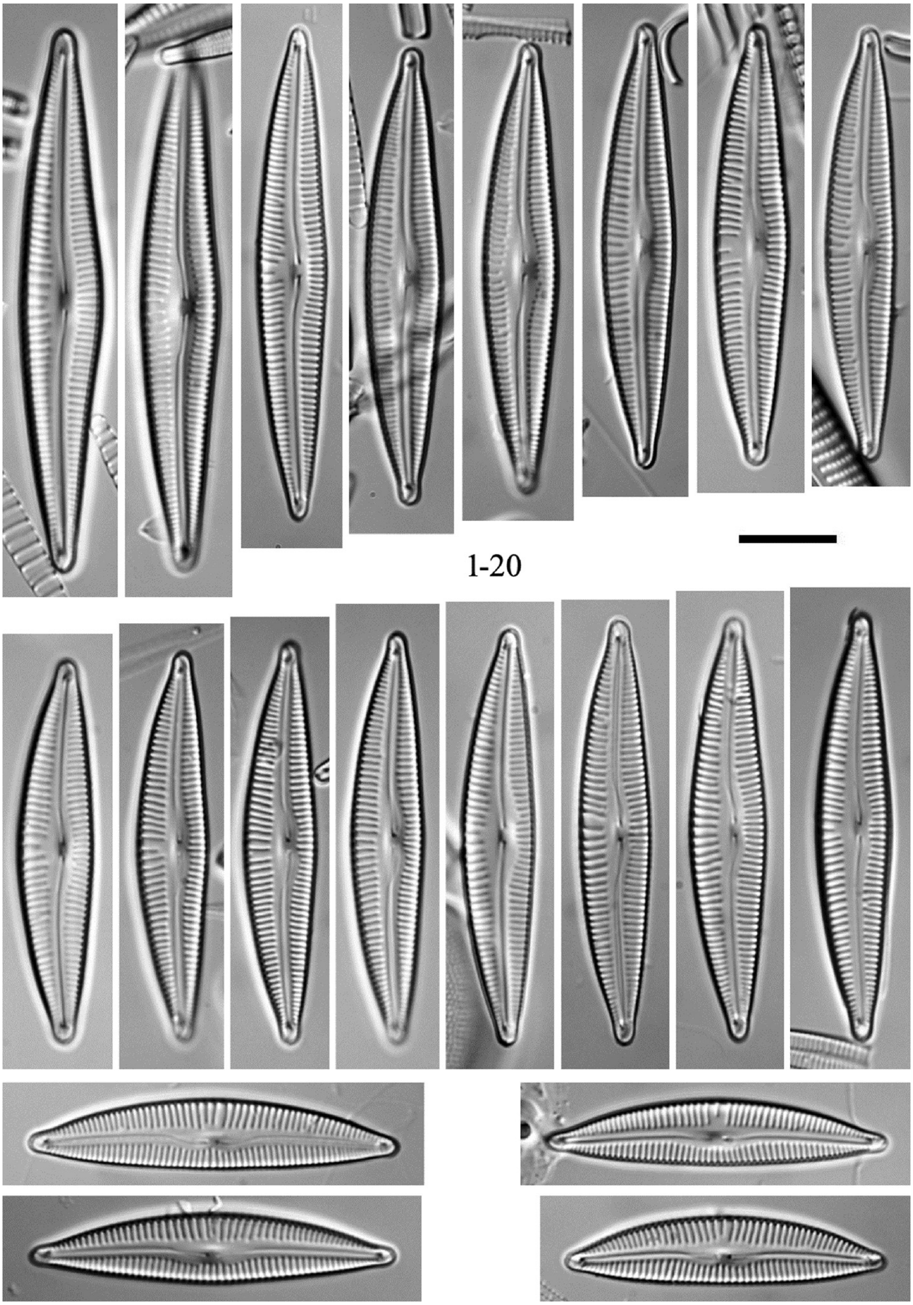

PLATE 102 – *Cymbopleura* sp. 3. nov. (1.–20.).

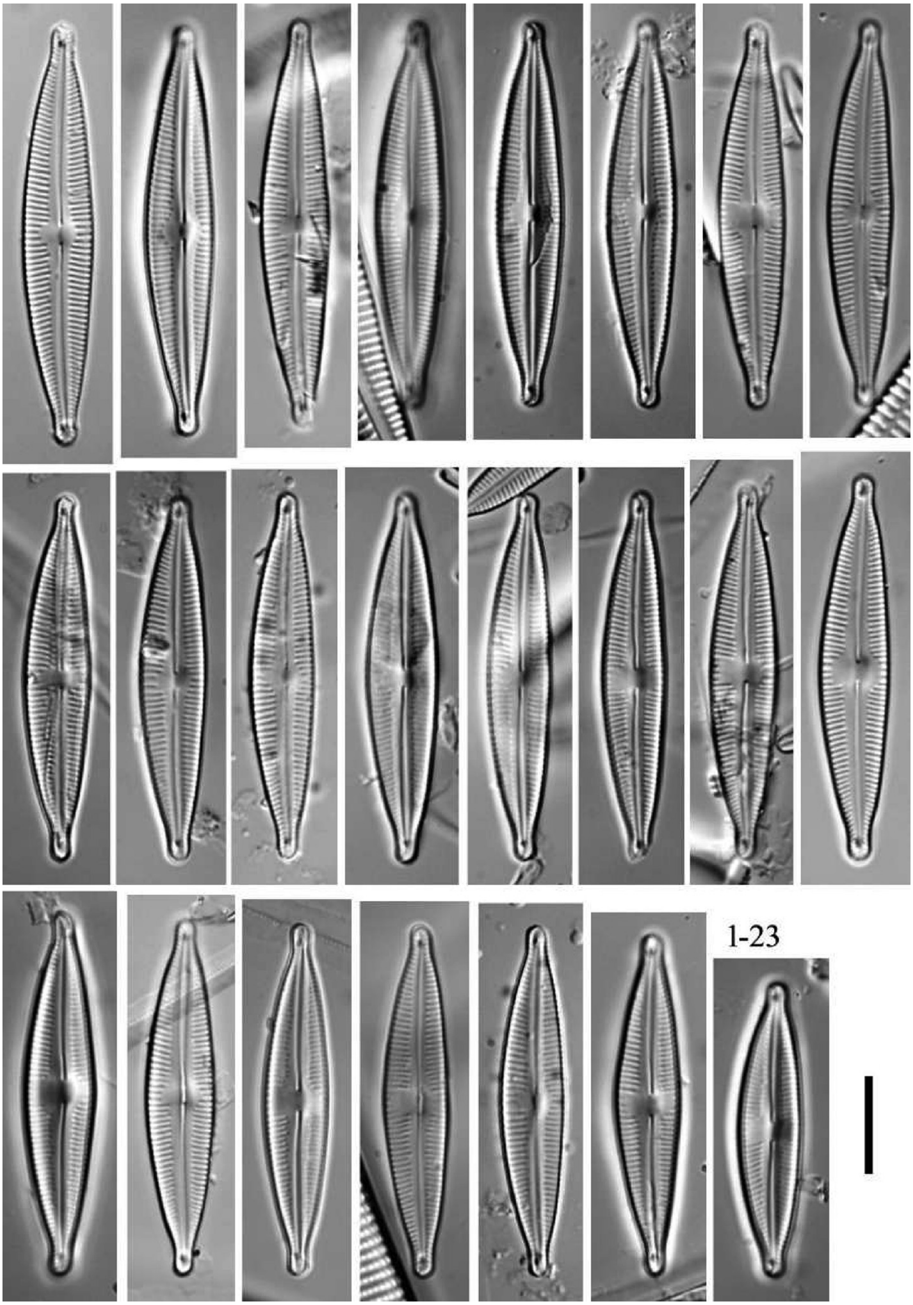

PLATE 103 – *Cymbopleura* aff. *lapponica* (Grunow) Krammer (1.–23.).

PLATE 104. *Cymbopleura* aff. *stauroneiformis* (Lagerstedt) Krammer

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Figs 1–23. *Cymbopleura* aff. *stauroneiformis* (Lagerstedt) Krammer

Valves are slightly dorsiventral, rhombic-lanceolate with dorsal margin convex and ventral margin slightly convex. Valve ends are narrowly protracted. Valve length is 22–45 μm, valve width is 8.0–9.5 μm. The axial area is moderately wide, linear, and slightly widened near the central area. The central area is wide, usually broader on dorsal side, asymmetric, rectangular from dorsal side, and round on the ventral side. In some specimens central striae might be more distantly spaced. The raphe is lateral becoming slightly reverse lateral towards proximal ends. Proximal raphe ends are deflected ventrally and slightly expanded. Distal raphe fissures are deflected dorsally. Striae radiate throughout and indistinctly punctate, 16–20 in 10 μm.

Cymbopleura aff. *stauroneiformis* closely resembles *C. stauroneiformis* and with respect to the valve size, shape, and stria density. Differences can be noticed in the shape of the central area, whereas in *C. stauroneiformis* is broad semifascia compared to asymmetric (rectangular from dorsal and round from ventral valve side) central area in this taxon.

Scale bar = 10 μm
LM 1500x

Figs 1–23. Jiuzhaigou National nature reserve, sample Acc. No. 54 MOU NIGOU.

PLATE 105. *Cymbopleura similiformis* Krammer, *Cymbopleura amphicephala* (Nägeli) Krammer, *Cymbopleura sublanceolata* Krammer, *Cymbopleura naviculiformis* (Auerswald) Krammer

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Figs 1–11. *Cymbopleura similiformis* Krammer

Valves are slightly dorsiventral, elliptic-lanceolate with both dorsal and ventral margins. Valve ends are long protracted and capitate. Valve length is 22–26 μm, valve width is 7.0–7.5 μm. The axial area is moderately narrow, lanceolate gradually widening towards the central area. The central area is narrow, and not defined, slightly wider than axial area. The raphe is lateral becoming slightly filiform towards proximal ends. Proximal raphe ends are deflected ventrally and slightly expanded. Distal raphe fissures are deflected dorsally. Striae radiate throughout and indistinctly punctate, 11–14 in 10 μm.

Cymbopleura similiformis is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 12–18. *Cymbopleura amphicephala* (Nägeli) Krammer

Valves are slightly dorsiventral, elliptic-lanceolate with dorsal strongly convex and ventral margin slightly convex to straight. Valve ends are capitate. Valve length is 22–27 μm, valve width is 6.5–7.0 μm. The axial area is narrow, linear. The central area is narrow, and not defined, slightly wider than axial area. Central striae usually are more distantly spaced. The raphe is lateral becoming slightly filiform towards proximal ends. Proximal raphe ends are deflected ventrally and slightly expanded. Distal raphe fissures are deflected dorsally. Striae radiate throughout and indistinctly punctate, 12–14 in 10 μm.

Cymbopleura amphicephala is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 19–23. *Cymbopleura sublanceolata* Krammer

Figs 24, 25. *Cymbopleura naviculiformis* (Auerswald) Krammer

Scale bar = 10 μm
LM 1500x

Figs 1–25. Jiuzhaigou National nature reserve, sample Acc. No. 54 MOU NIGOU.

PLATE 106. *Reimeria uniseriata* S.E. Sala, J.M. Guerrero & M.E. Ferrario, *Reimeria ovata* (Hustedt) Levkov & Ector, *Reimeria sinuata* (W. Gregory) Kociolek & Stoermer, *Cymbellafalsa* sp. 1. nov.

Figs 1–9. *Reimeria uniseriata* S.E. Sala, J.M. Guerrero & M.E. Ferrario

Valves are linear-lanceolate, dorsiventral with convex dorsal margin and ventral margin almost straight with medial expansion. Valve ends are subcapitate and broadly rounded. Valve length is 24–28 μm valve width is 5.5–6.5 μm. Axial area is narrow, and linear. Central area is broad, rectangular, reaching the valve margin at ventral side, and bordered by a single stria from dorsal side. One isolated stigma is present near the central nodule. The raphe is straight, with the terminal raphe fissures curved to the ventral side. Apical pore fields are present on the ventral mantle and split by the terminal raphe fissures Striae are uniseriate, 8–10 in 10 μm in the middle of the dorsal side. Areolae are coarse 17–20 in 10 μm.

Reimeria uniseriata is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 10–13. *Reimeria ovata* (Hustedt) Levkov & Ector

Reimeria ovata is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Figs 14–18. *Reimeria sinuata* (W. Gregory) Kociolek & Stoermer
Figs 19–37. *Cymbellafalsa* sp. 1. nov.

Valves are linear-elliptic to elliptic-lanceolate, almost symmetrical to weakly dorsiventral, and slightly protracted and broadly rounded ends. Valve length is 20–31 μm valve width is 6.5–8.0 μm. Axial area is narrow, linear. Central area is small, irregular to round. The raphe is filiform, with proximal raphe ends deflected to the primary valve side, and the terminal raphe fissures curved to the secondary side. Apical pore fields are present on both poles. Striae are uniseriate, 12–15 in 10 μm in the middle of the dorsal side. Areolae not discernible with LM. This taxon was recorded also by Metzeltin *et al.* (2009, figs 56: 25–28) under name *Cymbellafalsa* (? spec. aff.) *diluviana* (Krasske) Lange-Bertalot & Metzeltin. It differs from *Cymbellafalsa diluviana* by narrower, linear-elliptic to elliptic-lanceolate valves.

Scale bar = 10 μm
LM 1500x

Figs 1–37. Jiuzhaigou National nature reserve, sample Acc. No. 41 JG PP1.

PLATE 107. *Amphora ovalis* (Kützing) Kützing

Figs 1–6. *Amphora ovalis* (Kützing) Kützing

Frustules are broadly elliptical. Valves are semi-elliptical with smoothly arched dorsal margins and straight or slightly concave ventral margin, valve ends obtusely rounded. Valve length 60–88 μm, valve breadth 12–15 μm. Axial area moderately narrow, arched. Central area on dorsal side absent, broad fascia on the ventral side. Raphe branches biarcuate, proximal and distal raphe endings dorsally bent. Dorsal striae, coarsely punctate, except striae in the middle of the valve appearing as transapical lines radiate throughout 11–13 in 10 μm. Ventral striae radiate in the middle, becoming convergent towards the valve ends, comprise single areola, 9–11 in 10 μm.

Amphora ovalis is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–6. Jiuzhaigou National nature reserve, sample Acc. No. 59 H PER1.

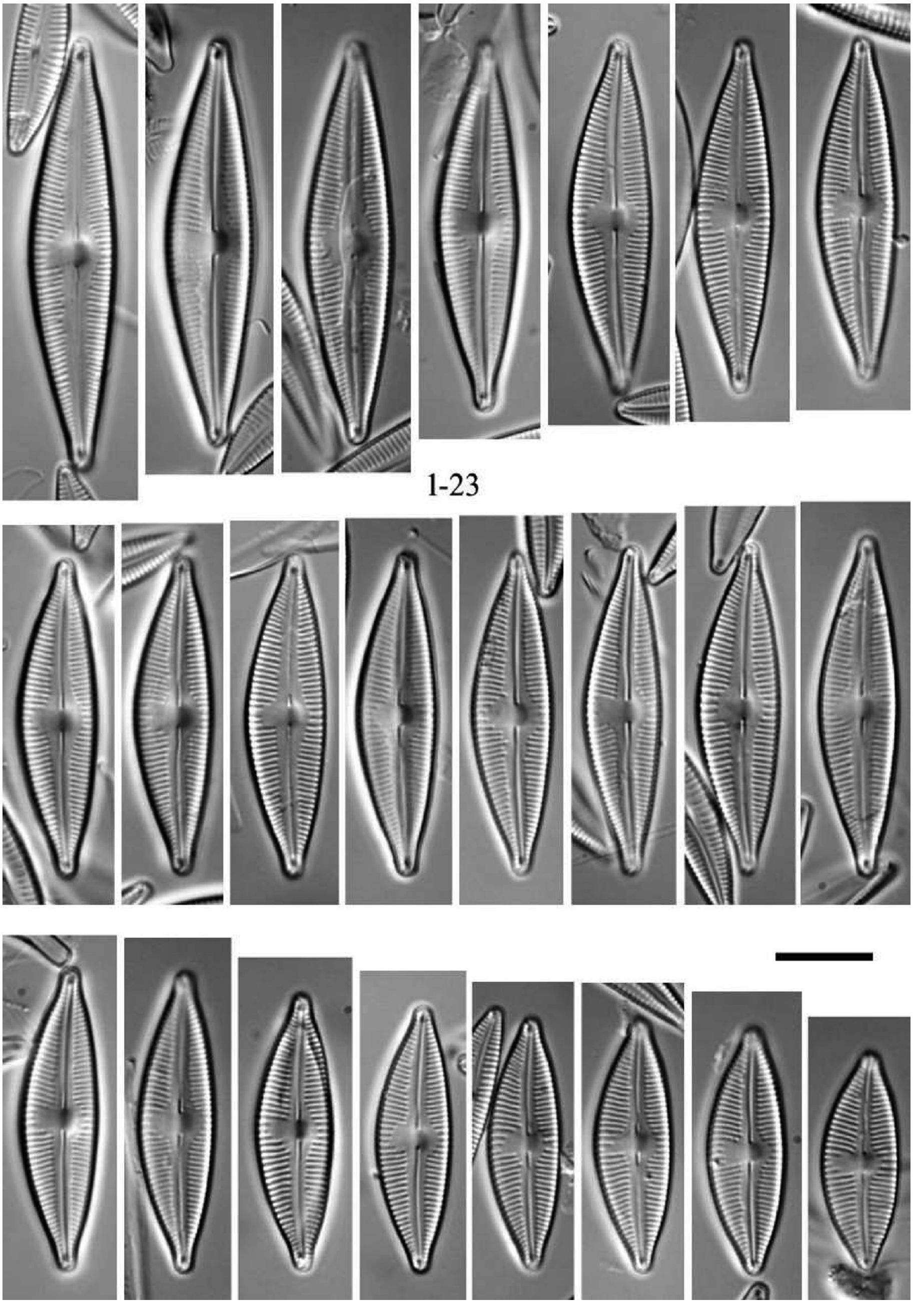

PLATE 104 – *Cymbopleura* aff. *stauroneiformis* (Lagerstedt) Krammer (1.–23.).

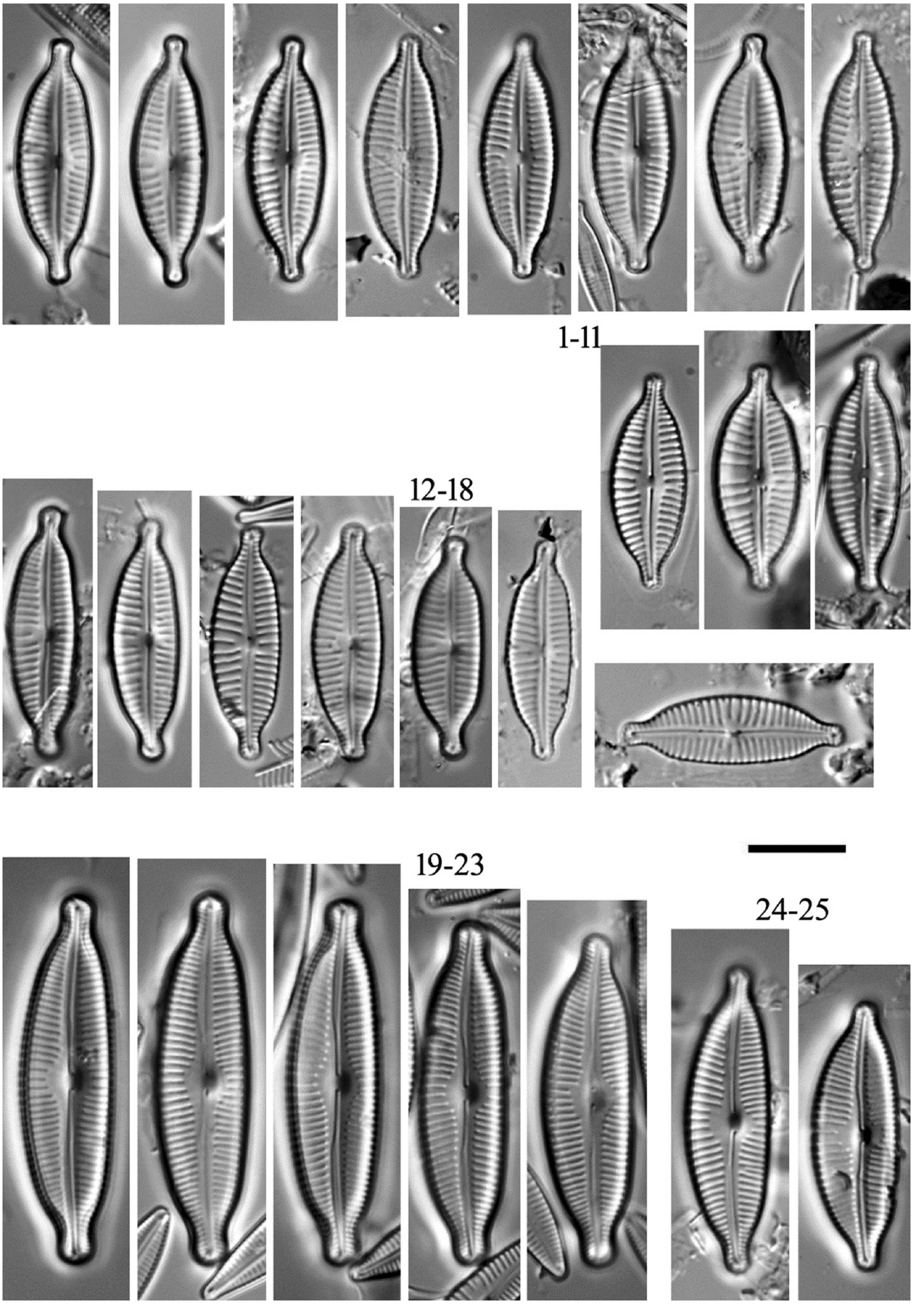

PLATE 105 – *Cymbopleura similiformis* Krammer (1.–11.), *Cymbopleura amphicephala* (Nägeli) Krammer (12.–18.), *Cymbopleura sublanceolata* Krammer (19.–232.), *Cymbopleura naviculiformis* (Auerswald) Krammer (24., 25.).

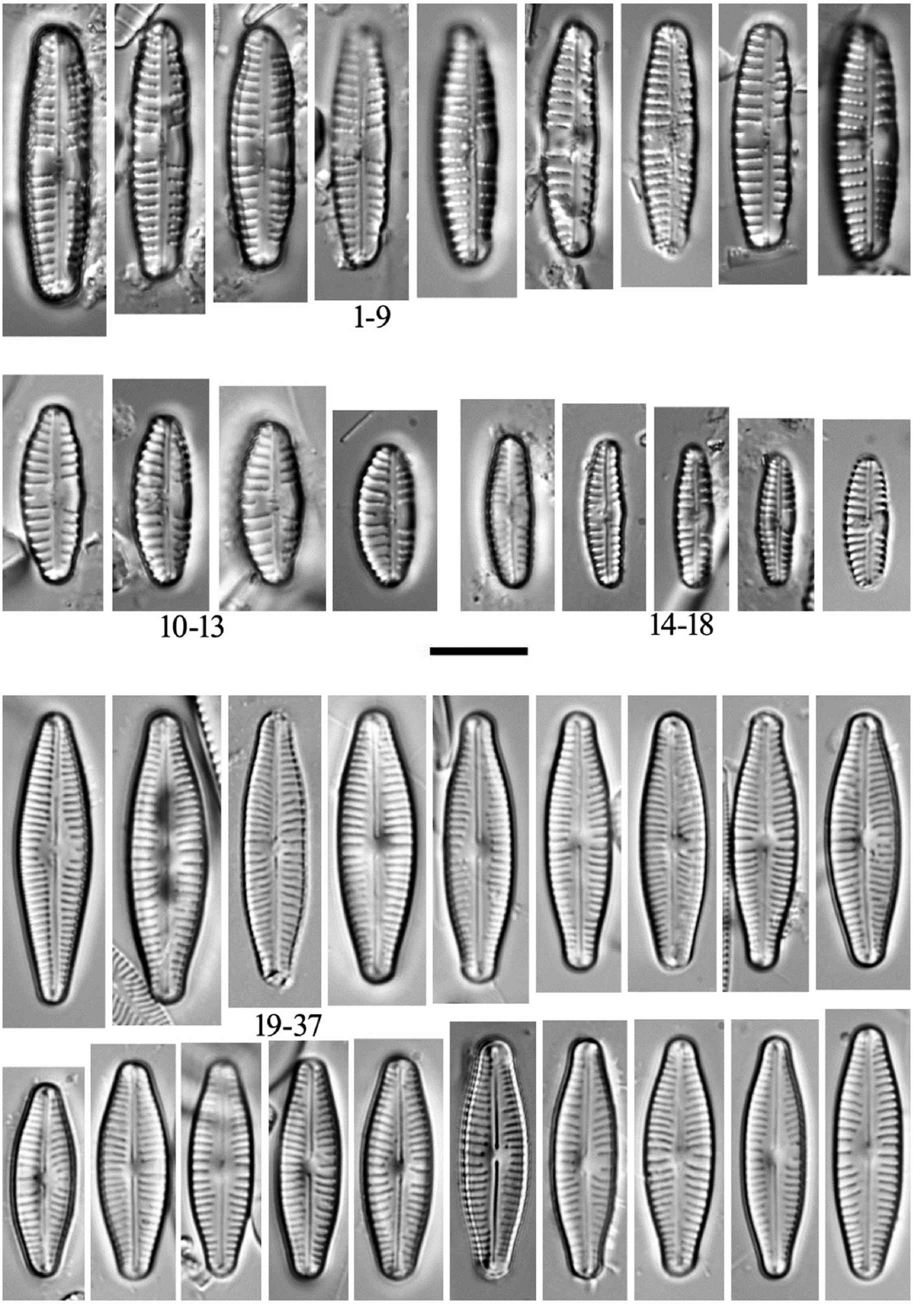

Plate 106 – *Reimeria uniseriata* S.E. Sala, J.M. Guerrero & M.E. Ferrario (1.–9.), *Reimeria ovata* (Hustedt) Levkov & Ector (10.–13.), *Reimeria sinuata* (W. Gregory) Kociolek & Stoermer (14.–18.), *Cymbellafalsa* sp. 1. nov. (19.–37.).

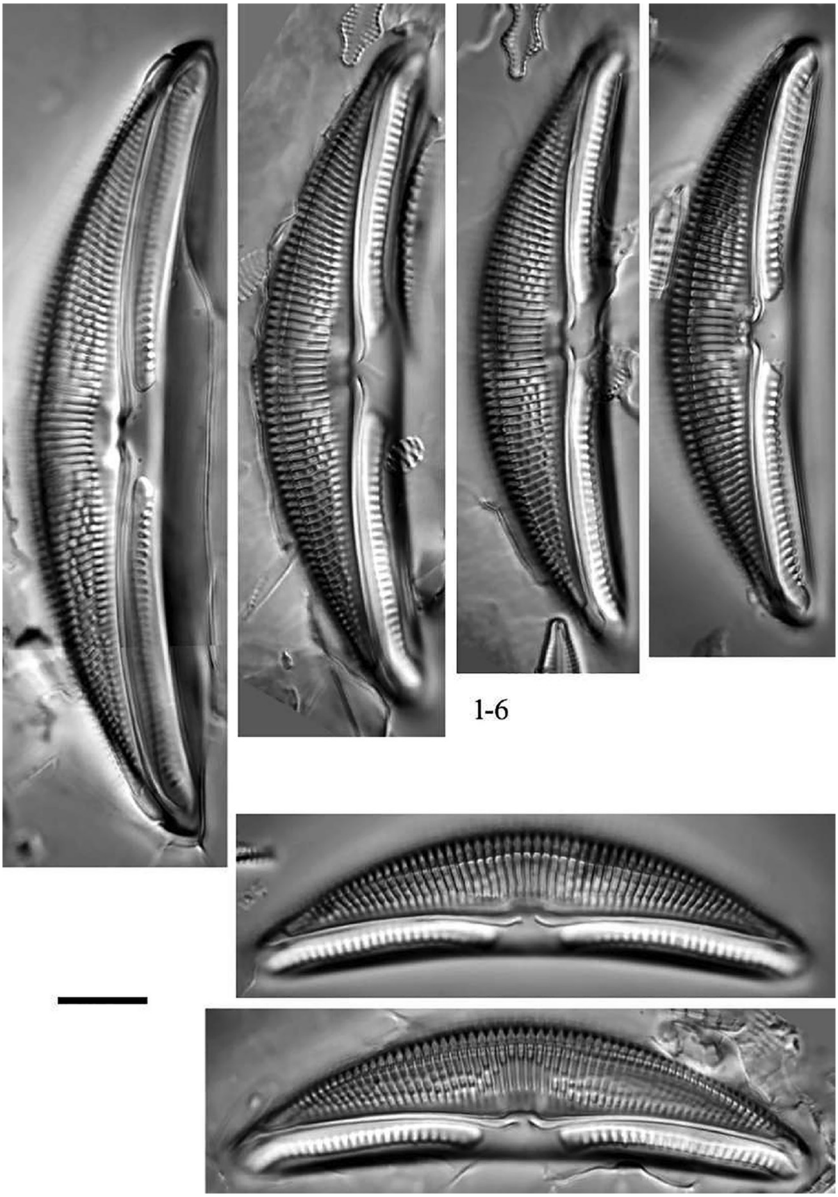

Plate 107 – *Amphora ovalis* (Kützing) Kützing (1.–6.).

PLATE 108. *Amphora alpestris* Levkov, *Halamphora veneta* (Kützing) Levkov, *Halamphora normanii* var. *undulata* (Krasske) Levkov, *Halamphora normanii* (Rabenhorst) Levkov, *Amphora inariensis* Krammer, *Amphora copulata* (Kützing) Schoeman & R.E.M. Archibald, *Amphora pediculus* (Kützing) Grunow, *Halamphora thumensis* (A. Mayer) Levkov

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Figs 1–13. *Amphora alpestris* Levkov

Frustules are broadly elliptical. Valves are semi-lanceolate, with smoothly arched dorsal margin and slightly concave ventral margin, occasionally weakly inflated in the middle. Valve ends narrowly rounded and slightly ventrally bent. Valve length is 24–45 μm, valve breadth is 5.5–9.0 μm, frustule breadth is 15–20 μm. Axial area narrow, biarcuate, central area on dorsal side wide, trapezoid, extending to the valve margin, broad fascia on the ventral side. Raphe branches biarcuate, proximal raphe endings strongly dorsally bent, distal dorsally curved. Dorsal striae coarsely punctate, parallel or weakly radiate in the middle, becoming strongly radiate towards the ends, 12–14 in 10 μm. Ventral striae radiate in the middle, convergent towards the valve ends, with two areolae, 10–13 in 10 μm.

Amphora alpestris is considered a widely spread (cosmopolitan) species (Levkov, 2009) and it was infrequently observed in the study area.

Fig. 14. *Halamphora veneta* (Kützing) Levkov

Figs 15, 16. *Halamphora normanii* var. *undulata* (Krasske) Levkov

Figs 17, 18. *Halamphora normanii* (Rabenhorst) Levkov

Figs 19–21. *Amphora inariensis* Krammer

Figs 22–24. *Amphora copulata* (Kützing) Schoeman & R.E.M. Archibald

Figs 25–27. *Amphora pediculus* (Kützing) Grunow

Figs 28–34. *Halamphora thumensis* (A. Mayer) Levkov

Valves broadly lanceolate, dorsiventral with strongly arched dorsal margin and convex ventral margin. Valve ends are protracted, broadly rounded. Valve length is 9–14 μm, valve width is 4.0–5.0 μm. Axial area is very narrow. Central area on dorsal valve side is semi-lanceolate in larger specimens or weakly expanded to absent in smaller specimens, on ventral side small rectangular fascia extending to the valve margin. Raphe branches straight or weakly arched with proximal raphe endings slightly expanded into central pores. Dorsal striae without punctation, parallel in the middle, becoming radiate towards the valve ends, 22–24 in 10 μm. Ventral striae indistinct, hard to resolve with LM.

Scale bar = 10 μm
LM 1500x

Figs 1–34. Jiuzhaigou National nature reserve, various samples.

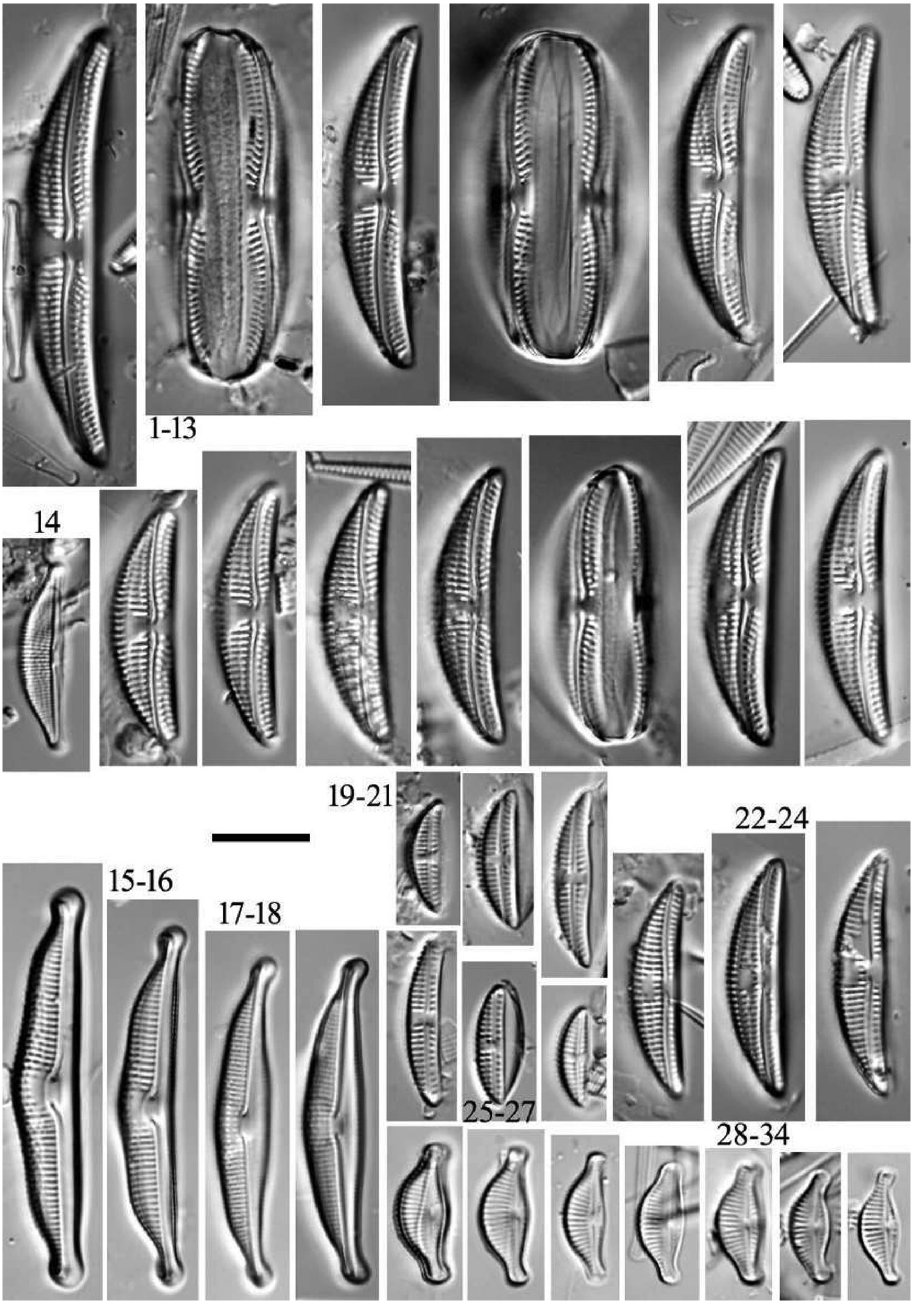

PLATE 108 – *Amphora alpestris* Levkov (1.–13.), *Halamphora veneta* (Kützing) Levkov (14.), *Halamphora normanii* var. *undulata* (Krasske) Levkov (15., 16.), *Halamphora normanii* (Rabenhorst) Levkov (17., 18.), *Amphora inariensis* Krammer (19.–21.), *Amphora copulata* (Kützing) Schoeman & R.E.M. Archibald (22.–24.), *Amphora pediculus* (Kützing) Grunow (25.–27.), *Halamphora thumensis* (A. Mayer) Levkov (28.–34.).

PLATE 109. *Halamphora oligotraphenta* (Lange-Bertalot) Levkov

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Figs 1–35. *Halamphora oligotraphenta* (Lange-Bertalot) Levkov

Valves semi-lanceolate, dorsiventral with smoothly arched dorsal margin and straight to slightly tumid ventral margin. Valve ends shortly protracted, capitate and slightly ventrally bent. Valve length is 17–35 μm, valve width is 3.5–5.5 μm. Axial area is narrow, wider on ventral valve side. Central area on dorsal side is absent, on ventral side cannot be differentiated from axial area. Raphe is weakly arched with proximal endings distantly spaced and slightly dorsally bent. Dorsal striae are fine punctate, and radiate throughout, 26–30 in 10 μm. Ventral striae are indistinct, hard to resolve with LM.

Halamphora oligotraphenta is considered a widely spread (cosmopolitan) species and it was infrequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–35. Jiuzhaigou National nature reserve, sample Acc. No. 71 – 5H.

PLATE 110. *Didymosphenia geminata* (Lyngbye) M. Schmidt

Figs 1–4. *Didymosphenia geminata* (Lyngbye) M. Schmidt

Valves are large and slightly asymmetric to the apical axis. Headpole is distinct, capitate, footpole is less capitate to bluntly rounded. Valve length is 80–140 μm, valve width is 35.0–40.0 μm. The axial area is linear and the central area is large oval. Stigmata 2–5 are present in the central area. The number of stigmata is positively related to valve size. The raphe is lateral, with expanded proximal raphe ends and deflected distal raphe ends. The distal raphe is deflected near the apical pore field (APF) at the footpole, but does not pass through the APF. The APF is large, distinct and composed of fine porelli. The striae are radiate for most of the valve, except near the footpole, where they become nearly parallel, 7–9 in 10 μm. Striae near the valve center are irregularly shortened. The areolae are complex, externally the areolae are located within ornamented depressions.

Didymosphenia geminata is considered a widely spread (cosmopolitan) species and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1200x

Figs 1–4. Jiuzhaigou National nature reserve, sample Acc. No. 4.

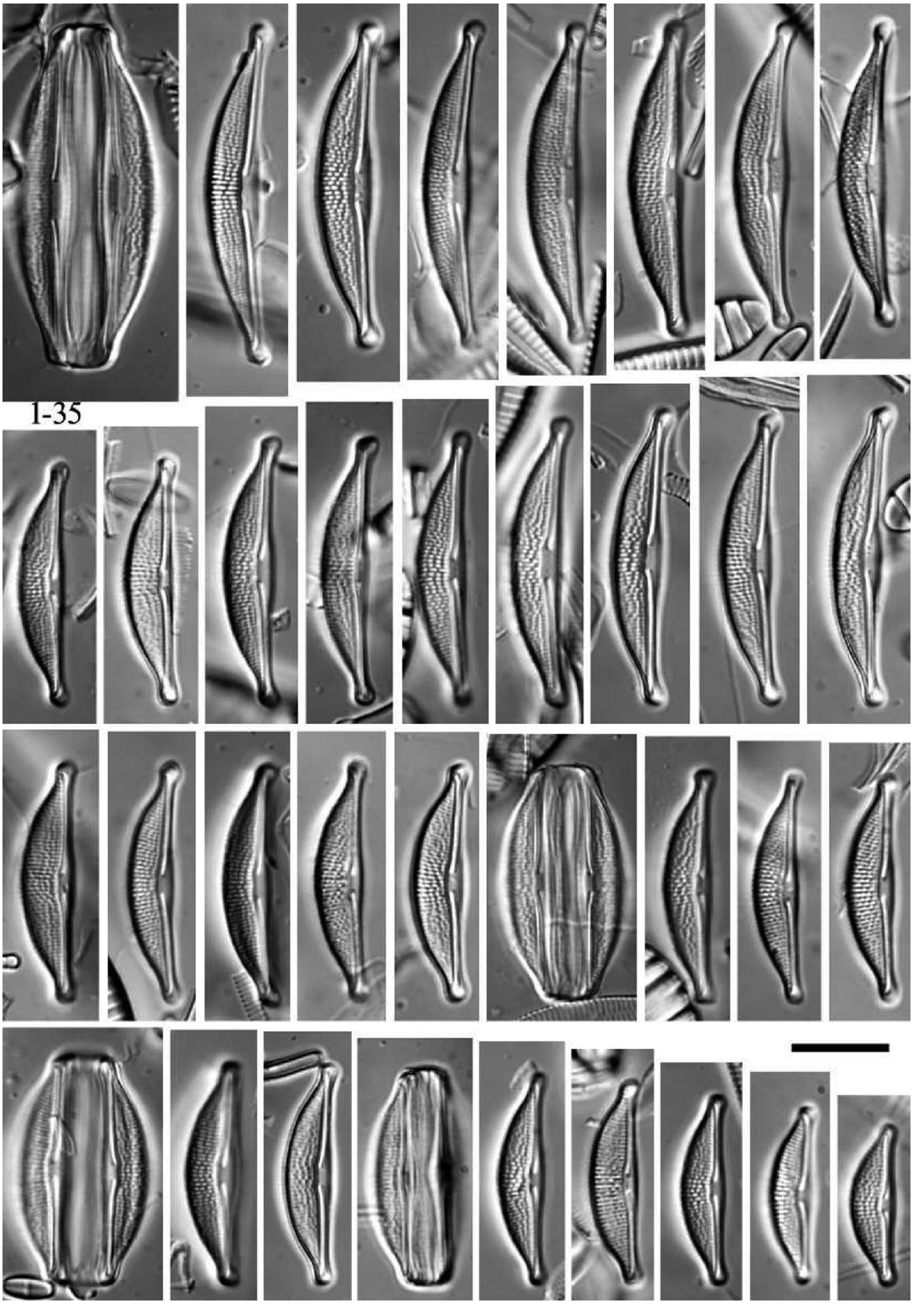

PLATE 109 – *Halamphora oligotraphenta* (Lange-Bertalot) Levkov (1.–35.).

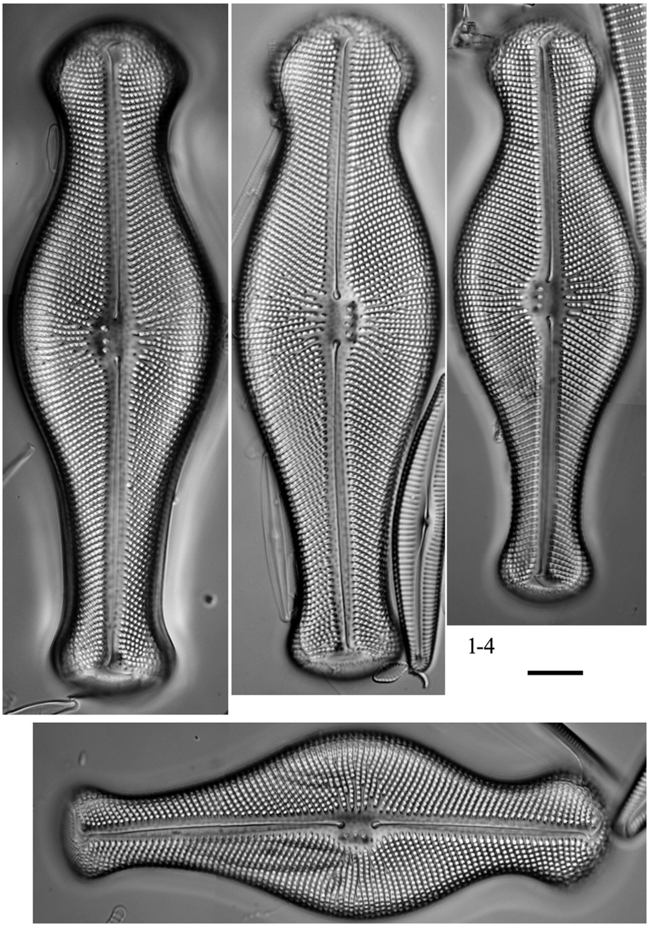

Plate 110 – *Didymosphenia geminata* (Lyngbye) M. Schmidt (1.–4.).

PLATE 111. *Gomphonema acuminatum* Ehrenberg

Figs 1–16. *Gomphonema acuminatum* Ehrenberg

Valves strongly heteropolar, clavate, with largest valve width near the headpole. Valves tumid at mid-valve, with two constrictions along the margin. Near the headpole valves broaden and become apiculate. Footpole rounded. Valve length 42–57 μm, width at headpole 11.0–13.5 μm, 8.0–10.5 μm at mid-valve. Axial area narrow, lanceolate. Central area small, irregular in shape, wider on the side opposite to the isolated pore. One isolated pore present at the end of the long, central stria. Raphe clearly lateral, undulated with simple, slightly expanded proximal raphe endings. Proximal raphe endings expanded, tear-drop-shaped, slightly deflected towards the isolated pore. At the footpole, distal raphe bisecting a well-developed apical pore field. At the headpole, distal raphe ends deflected first towards the pore-bearing side, and then deflected to opposite side, extending onto the valve mantle. Striae in LM coarse, parallel in mid-valve, 10–13 in 10 μm, becoming radiate and denser (12–15 in 10 μm) towards headpole and footpole. Areolae hardly distinguishable in LM, around 22–28 in 10 μm.

Gomphonema acuminatum is considered a widely spread (cosmopolitan) species and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

The genus Gomphonema is very diverse in P.R. China with many interesting and endemic species. Recently several new species have been described such as *Gomphonema qingyiensis* L.-X. Zhang, P. Yu & Q.-M. You, *Gomphonema tumidum* Y. Liu & Kociolek (in Jiang *et al.*, 2018), *Gomphonema bicepiforme* Wei Zhang & Kociolek (in Zhang *et al.*, 2018b), *Gomphonema wuyiense* W. Zhang & Kociolek (in Zhang *et al.*, 2018c), *Gomphonema yunnaniana*, Y. Liu & Kociolek (in Liu *et al.*, 2020b) and other.

Scale bar = 10 μm
LM 1500x

Figs 1–16. Jiuzhaigou National nature reserve, sample Acc. No. 42.

PLATE 112. *Gomphonema vibrio* Ehrenberg

Figs 1–11. *Gomphonema vibrio* Ehrenberg

Valves strongly heteropolar, clavate, to linear-lanceolate with weakly inflated centre, and broadly rounded head pole, narrowly rounded to cuneate foot pole. Valve length is 59–90 μm, valve width is 8.0–11.0 μm at mid-valve. Axial area narrow, lanceolate. Central area small, irregular in shape, wider on the side opposite to the isolated pore. One isolated pore present at the end of the long, central stria. Raphe clearly lateral, undulated with simple, slightly expanded proximal raphe endings. Proximal raphe endings expanded, tear-drop-shaped, slightly deflected towards the isolated pore. At the footpole, distal raphe bisecting a well-developed apical pore field. At the headpole, distal raphe ends deflected first towards the pore-bearing side, and then deflected to opposite side, extending onto the valve mantle. Striae in LM coarse, parallel in mid-valve, 7–9 in 10 μm. Areolae hardly distinguishable in LM, around 25 in 10 μm.

Gomphonema vibrio is considered as widely spread (cosmopolitan) species and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm.
LM 1500x

Figs 1–11. Jiuzhaigou National nature reserve, sample Acc. No. D.

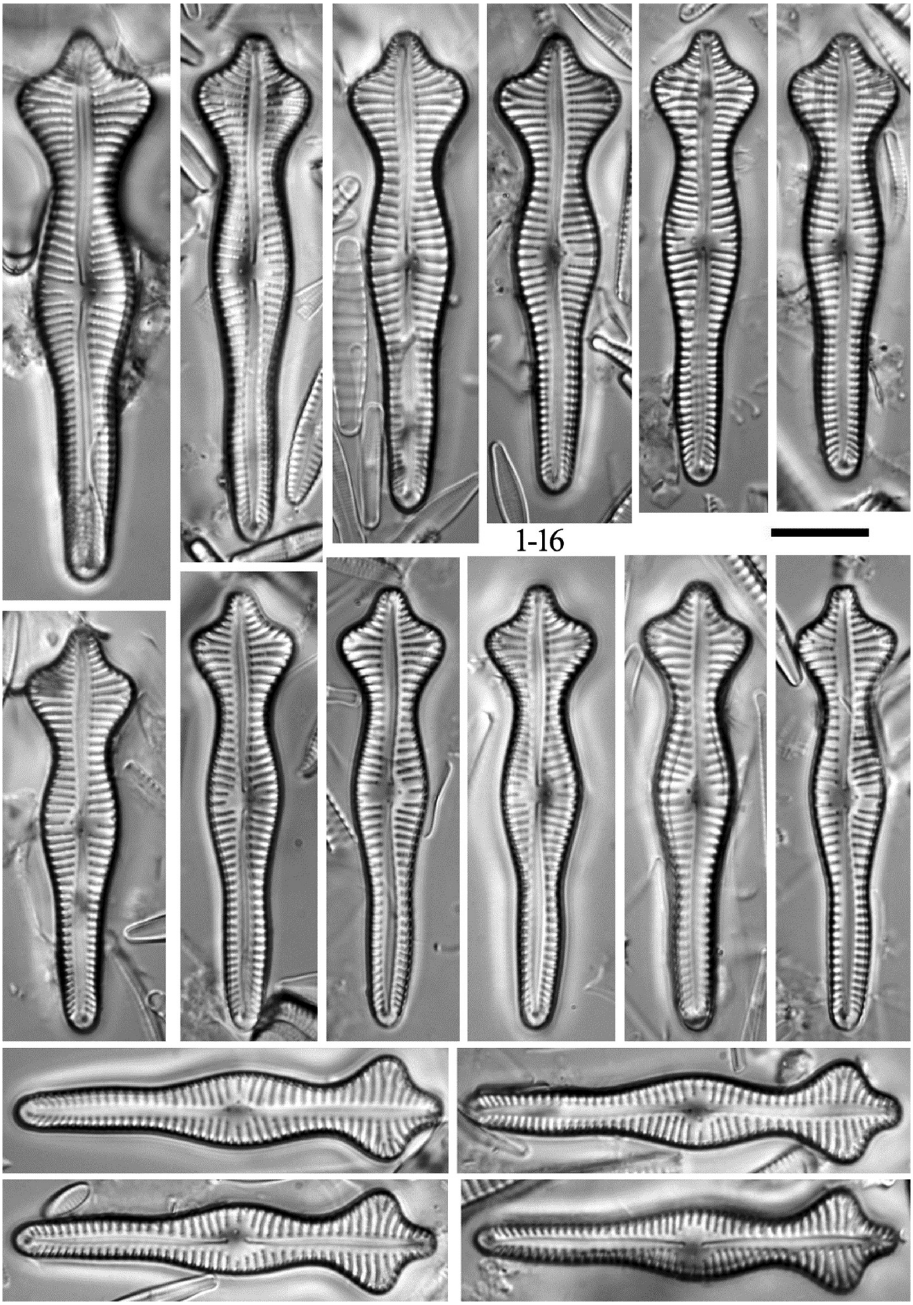

Plate 111 – *Gomphonema acuminatum* Ehrenberg (1.–16.).

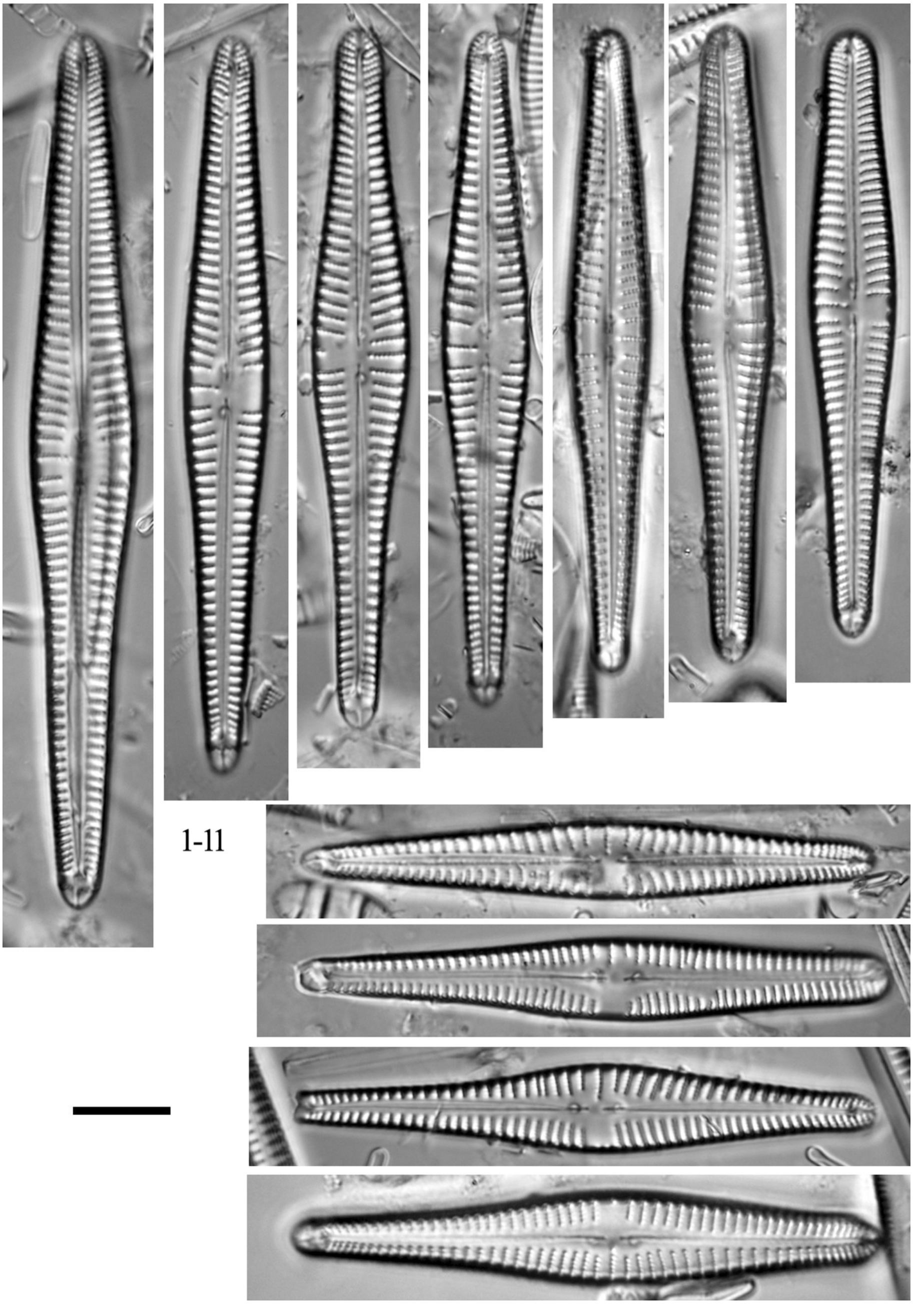

Plate 112 – *Gomphonema vibrio* Ehrenberg (1.–11.).

PLATE 113. *Gomphonema lateripunctatum* E. Reichardt

Figs 1–26. *Gomphonema lateripunctatum* E. Reichardt

Frustules in girdle view are wedge-shaped. Valves are slightly heteropolar, narrowly clavate to lanceolate, with largest valve width near mid-valve. Valve margins are slightly constricted towards the headpole and footpole. Headpole is broadly rounded, footpole is protracted to sub-capitate. Valve length 27–49 μm, valve width 4.5–7.0 μm at the mid-valve. Axial area is moderately broad, lanceolate. Central area is large, transversely elongated, bordered on both sides with a single strongly shortened central stria. One isolated pore is present in the central area. Raphe is lateral and slightly undulated, proximally terminating with tear-drop-shaped endings. Proximal raphe endings slightly deflected towards the isolated pore. At the headpole, distal raphe ends deflected first towards the pore- bearing side and then deflected on the opposite side, extending onto the valve mantle. At the footpole, distal raphe bisecting a well-developed apical pore field. Striae in LM are fine, slightly radiate in mid-valve 8–14 in 10 μm, becoming strongly radiate towards the footpole, and parallel towards headpole. Striae much denser at the headpole. Areolae not distinguishable in LM, around 30 in 10 μm. *Gomphonema lateripunctatum* is considered a widely spread (cosmopolitan) species and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 14500x

Figs 1–26. Jiuzhaigou National nature reserve, sample Acc. No. 11.

PLATE 114. *Gomphonema kasnakowi* Mereschkowsky

Figs 1–15. *Gomphonema kasnakowi* Mereschkowsky

Valves are slightly heteropolar, narrowly clavate to lanceolate, with largest valve width near mid-valve. Valve margins are gradually tapering towards the broadly rounded headpole. Footpole is protracted to subcapitate and broadly rounded and footpole. Valve length is 39–71 μm, valve width is 9.5–11.0 μm at the mid- valve. Axial area is narrow, linear. Central area is large, transversely elongated, asymmetrical, wider on one side. Isolate pore is absent from central area. Raphe is lateral and slightly undulated, proximally terminating with tear-drop-shaped endings and hooked internally. At the headpole, distal raphe ends deflected first towards the pore-bearing side and then deflected on the opposite side, extending onto the valve mantle. At the footpole, distal raphe bisects a well-developed apical pore field. Striae in LM coarse, slightly radiate to parallel in mid-valve 8–10 in 10 μm, becoming slightly radiate towards the poles. Striae much denser at the poles. Areolae not distinguishable in LM.

Gomphonema kasnakowi probably is widely spread in Asia and in the study area was infrequently observed.

Scale bar = 10 μm
LM 1500x

Figs 1–15. Jiuzhaigou National nature reserve, sample Acc. No. D.

PLATE 115. *Gomphonema* sp. 1. nov.

Figs 1–20. *Gomphonema* sp. 1. nov.

Valves are slightly heteropolar, narrowly clavate to lanceolate, with largest valve width near mid-valve. Valve margins are gradually tapering towards the broadly rounded headpole. Footpole is slightly protracted to subcapitate and broadly rounded and footpole. Valve length is 26–51 μm, valve width is 6.5–8.5 μm at the mid-valve. Axial area is narrow, linear. Central area is large, transversely elongated, bordered on each side by two shortened and more distantly spaced striae. Isolate pore is absent from central area. Raphe is lateral and slightly undulated, proximally terminating with tear-drop-shaped endings and hooked internally. At the headpole, distal raphe ends deflected first towards the pore-bearing side and then deflected on the opposite side, extending onto the valve mantle. At the footpole, distal raphe bisecting a well-developed apical pore field. Striae in LM are coarse, slightly radiated in mid-valve, becoming strongly radiate 9–12 in 10 μm. Striae much denser at the poles. Areolae not distinguishable in LM.

Gomphonema sp. 1. was so far observed only in Jiuzhaigou National nature reserve and it is relatively rare.

Scale bar = 10 μm
LM 1500x

Figs 1–20. Jiuzhaigou National nature reserve, sample Acc. No. D.

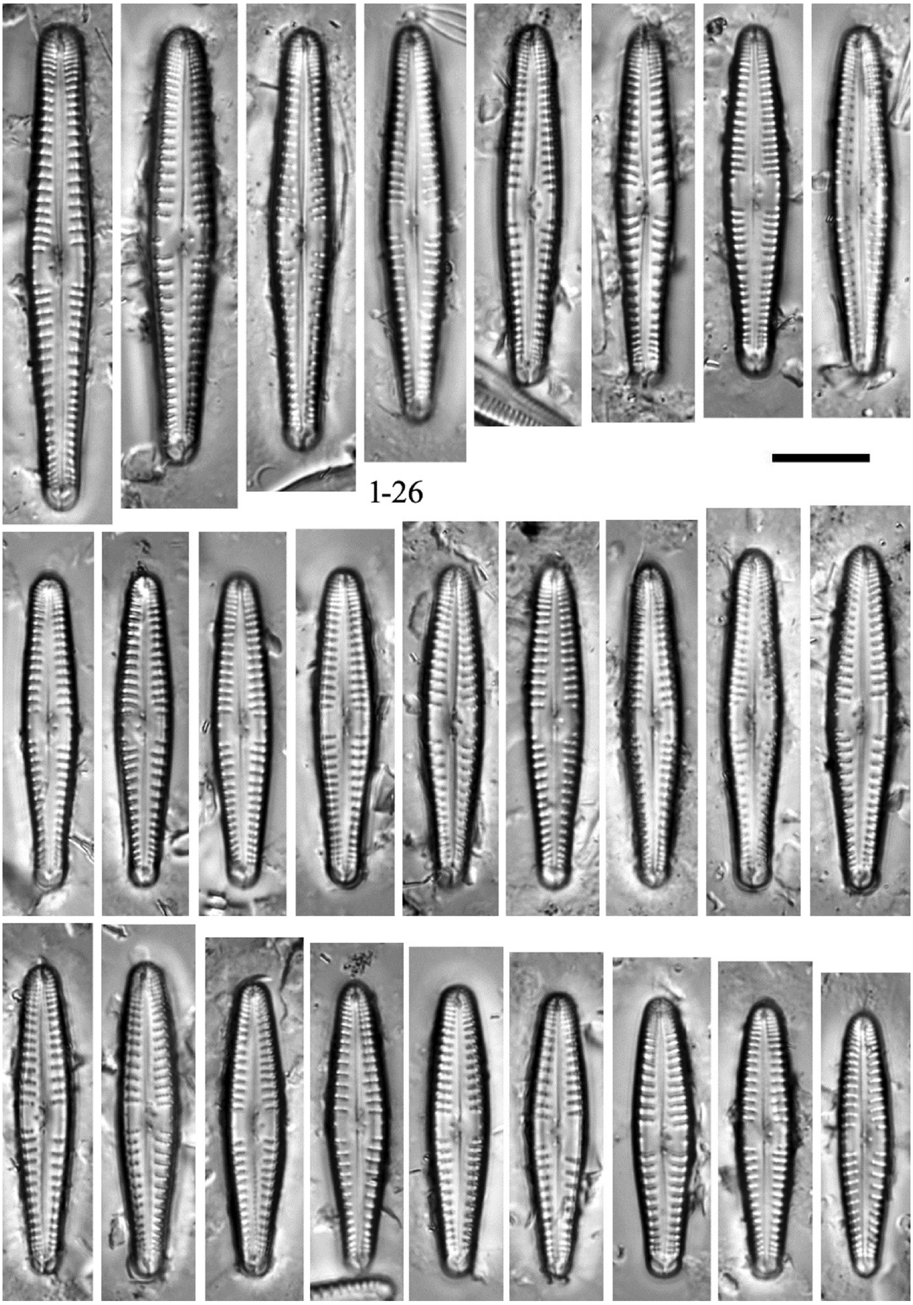

Plate 113 – *Gomphonema lateripunctatum* E. Reichardt (1.–26.).

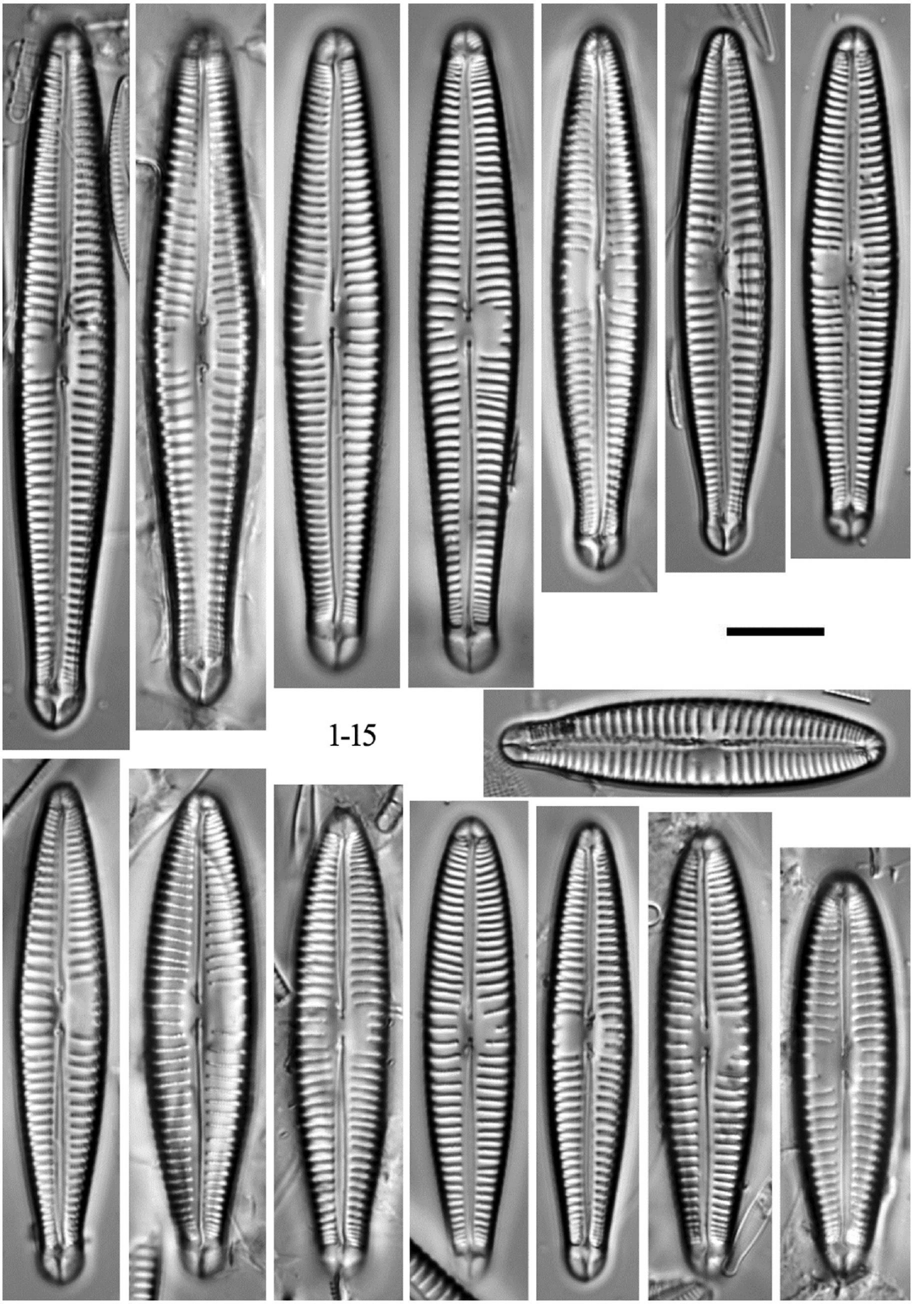

Plate 114 – *Gomphonema kasnakowi* Mereschkowsky (1.–15.).

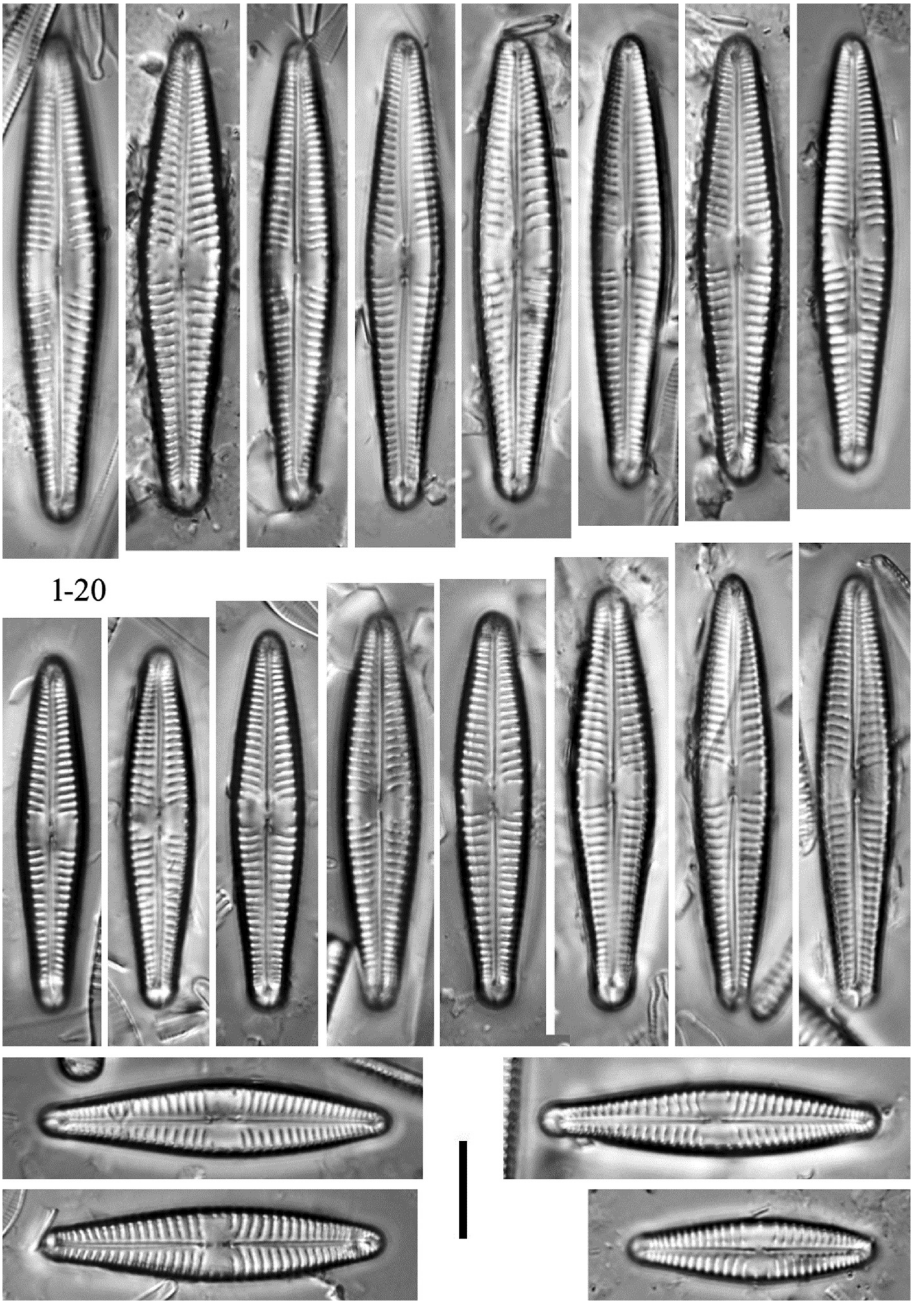

PLATE 115 – *Gomphonema* sp. 1. nov. (1.–20.).

PLATE 116. *Gomphonema tenue* Fricke

Figs 1–27. *Gomphonema tenue* Fricke

Valves are slightly heteropolar, narrowly clavate to lanceolate, with largest valve width near mid-valve. Valve margins in larger specimens are undulated while in medium and smaller specimens gradually taper towards the broadly rounded headpole and narrowly rounded footpole. Valve length is 29–57 μm, valve width is 6.5–8.5 μm at the mid-valve. Axial area is narrow, linear, slightly widened near the central area relatively small, transversely elongated, wider on the side opposite to the isolated pore. Isolate pore is present at the end of long central stria. Raphe is lateral, proximally terminating with tear-drop-shaped endings, and hooked internally. At the headpole, distal raphe ends are deflected first towards the pore-bearing side and then deflected on the opposite side, extending onto the valve mantle. At the footpole, distal raphe is bisecting a well-developed apical pore field. Striae in LM coarse, slightly radiate in mid-valve, becoming strongly radiate near footpole, 12–15 in 10 μm. Striae are much denser at the poles. Areolae not distinguishable in LM.

Gomphonema tenue is a rare taxon, typical for oligotrophic calcareous water habitats (Reichardt and Lange-Bertalot, 1991). In the study area, Jiuzhaigou National nature reserve was so far observed in several samples.

Scale bar = 10 μm
LM 1500x

Figs 1–27. Jiuzhaigou National nature reserve, sample Acc. No. 9.

PLATE 117. *Gomphonema elegantissimum* E. Reichardt & Lange-Bertalot

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Figs 1–42. *Gomphonema elegantissimum* E. Reichardt & Lange-Bertalot

Valves are slightly heteropolar, narrowly clavate to lanceolate, with largest valve width near mid-valve. Valve margins are gradually tapering towards the narrowly rounded headpole and footpole. Valve length is 16–31 μm, valve width is 3.5–4.0 μm at the mid-valve. Axial area is narrow, linear. Central area is small, transversely elongated, bordered on each side by a single shortened and more distantly spaced stria. Isolate pore is present in central area distantly from shortened central stria. Raphe is lateral and slightly undulated, proximally terminating with tear-drop-shaped endings and hooked internally. At the headpole, distal raphe ends are deflected first towards the pore-bearing side and then deflected on the opposite side, extending onto the valve mantle. At the footpole, distal raphe bisecting a well-developed apical pore field. Striae in LM are coarse, radiate in mid-valve, becoming strongly radiate 14–16 in 10 μm. Striae are much denser at the poles. Areolae not distinguishable in LM.

Gomphonema elegantissimum is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–42. Jiuzhaigou National nature reserve, sample Acc. No. 40.

PLATE 118. *Gomphonema* sp. 2. nov.

Figs 1–41. *Gomphonema* sp. 2. nov.

Valves are heteropolar to linear-lanceolate with largest valve width near headpole in upper valve half. Near the headpole valve broadens and becomes apiculate at the headpole. Footpole is narrowly rounded. Valve length is 17–29 μm, width at mid-valve is 3.0–3.5 μm, and at headpole 3.5–4.0 μm. Axial area is very narrow, linear. Central area is large, rectangular, unilaterally expanded, wider on the side opposite to the isolated pore, bordered on each margin by a single shortened stria. One isolated pore present at the end of long central stria. Raphe is lateral and undulated with simple, slightly expanded proximal raphe endings. Striae in LM are fine, radiate to parallel in mid-valve 10–14 in 10 μm, becoming strongly radiate towards the footpole.

Similar taxon was observed by Levkov *et al.* (2016) from Macedonia, identified as *Gomphonema* sp. aff. *insigniforme E. Reichardt & Lange-Bertalot (Levkov et al., 2016, figs 80:* 1–*22), but it has slightly wider a*nd longer valves. *Gomphonema* sp. 2. nov. very likely is unknown taxon that is so far observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–41. Jiuzhaigou National nature reserve, sample Acc. No. 42.

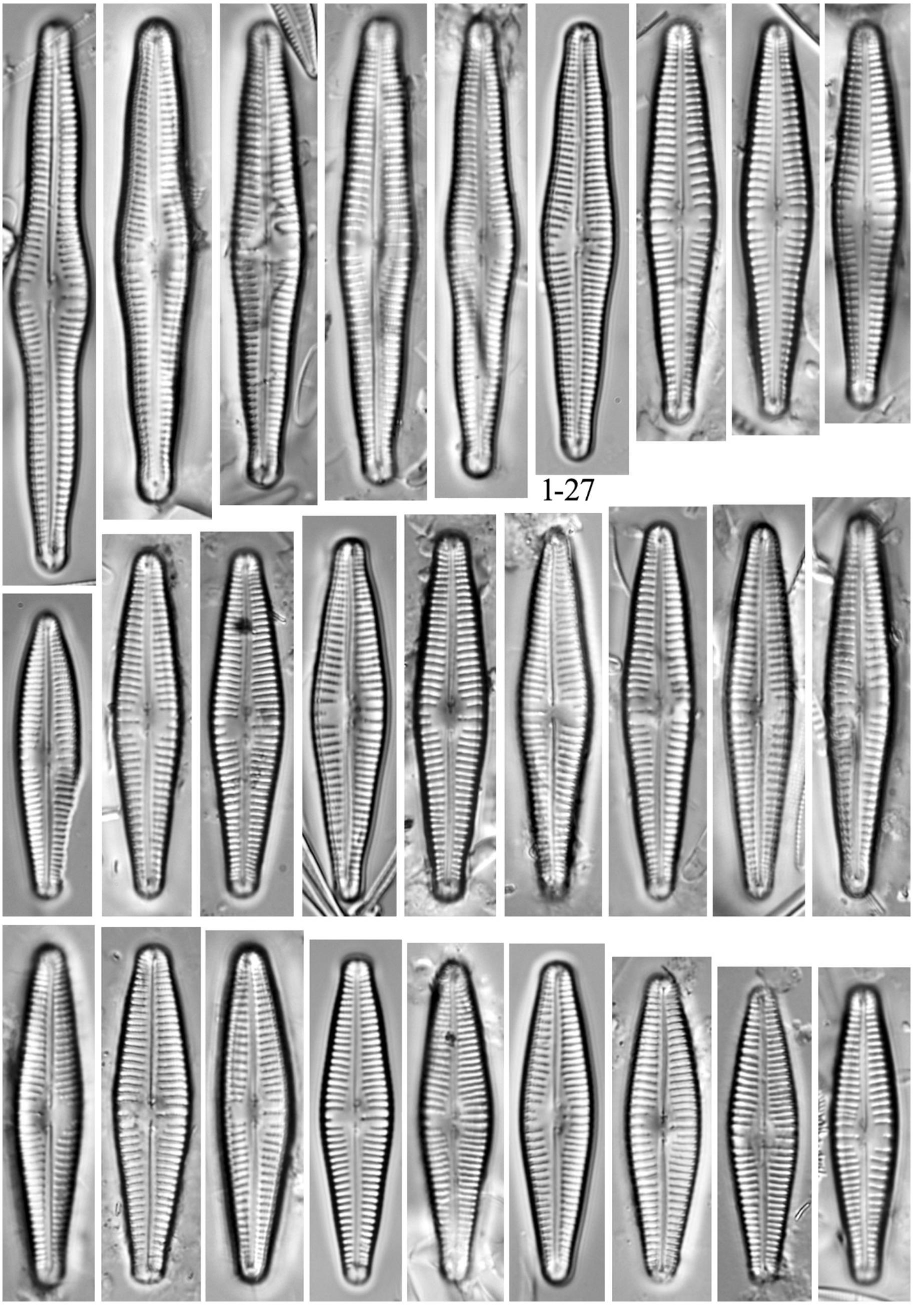

Plate 116 – *Gomphonema tenue* Fricke (1.–27.).

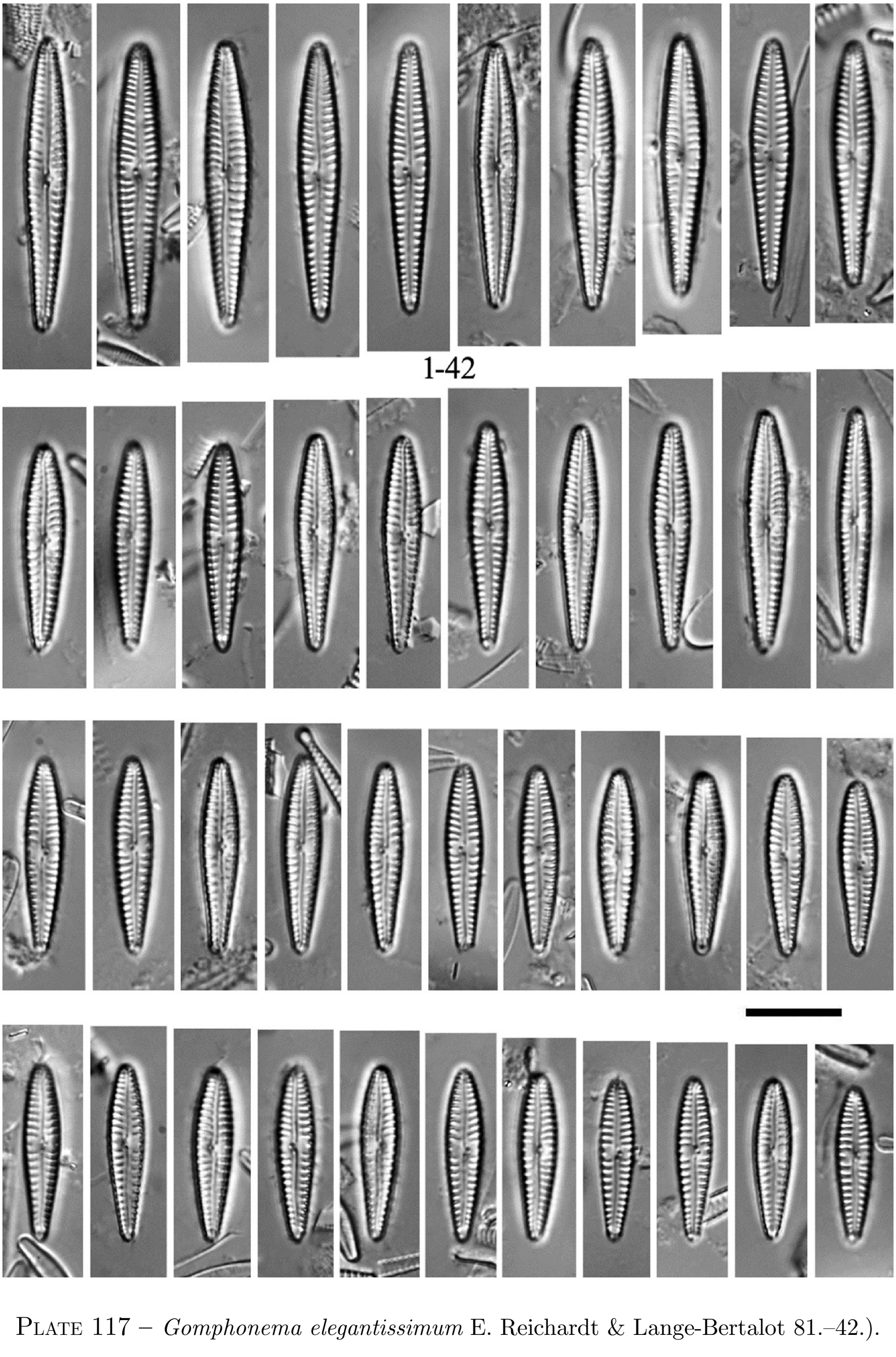

Plate 117 – *Gomphonema elegantissimum* E. Reichardt & Lange-Bertalot 81.–42.).

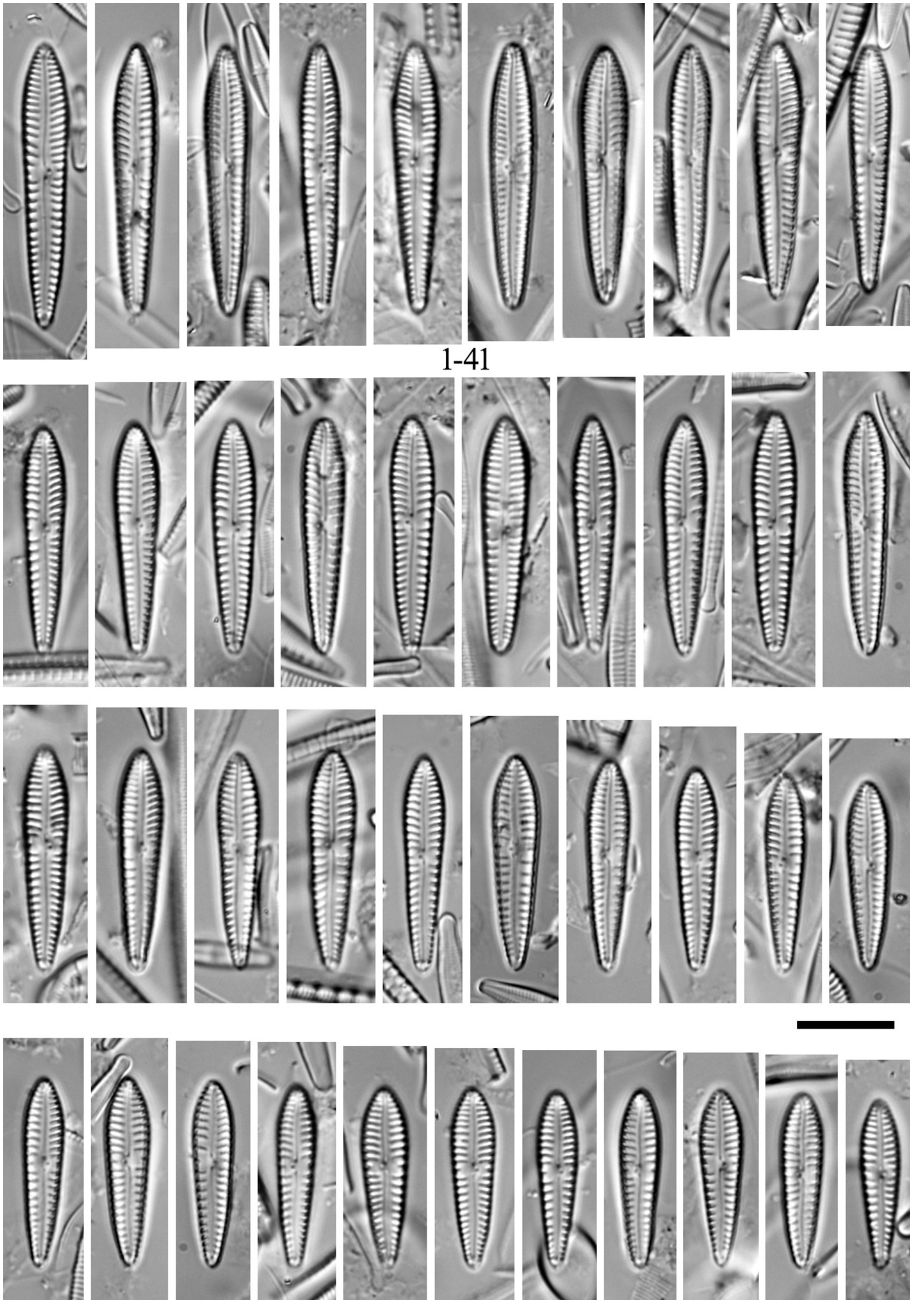

Plate 118 – *Gomphonema* sp. 2. nov. (1.–41.).

PLATE 119. *Gomphonema auritum* A. Braun ex Kützing

Figs 1–38. *Gomphonema auritum* A. Braun ex Kützing

Valves slightly heteropolar to almost symmetrical about apical axis, narrow rhombic-lanceolate with largest valve width near the mid-valve. Both headpole and footpole slightly rostrate. Valve length is 17–30 μm, valve width at mid-valve 3.5–5.0 μm. Axial area is very narrow, linear. Central area is small, rectangular, unilaterally expanded, and wider on the side opposite to the isolated pore bordered on each margin by a single shortened stria. One isolated pore is present at the end of slightly shortened central stria. Raphe is weakly lateral and undulated with simple proximal raphe endings. Striae in LM are fine, radiate throughout 17–20 in 10 μm.

Gomphonema auritum is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–38. Jiuzhaigou National nature reserve, sample Acc. No. 71 – 5H.

PLATE 120. *Gomphonema micropus* Kützing

Figs 1–30. *Gomphonema micropus* Kützing

Valves are heteropolar, clavate, to elliptic-lanceolate with broadly rounded and rostrate headpole and footpole. Valve is length 15–46 μm, width at mid-valve 6.0–9.0 μm. Axial area is narrow, linear. Central area is large, rectangular, and wider on the side opposite to the isolated pore, bordered on each margin by a single shortened stria. One isolated pore present at the end of long, central stria. Raphe is slightly lateral and undulated with simple slightly expanded proximal raphe endings. Striae in LM are fine, slightly radiate and curved in the middle, becoming radiate to parallel towards the poles 8–15 in 10 μm.

Gomphonema micropus is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–30. Jiuzhaigou National nature reserve, sample Acc. No. 60 – H PER1.

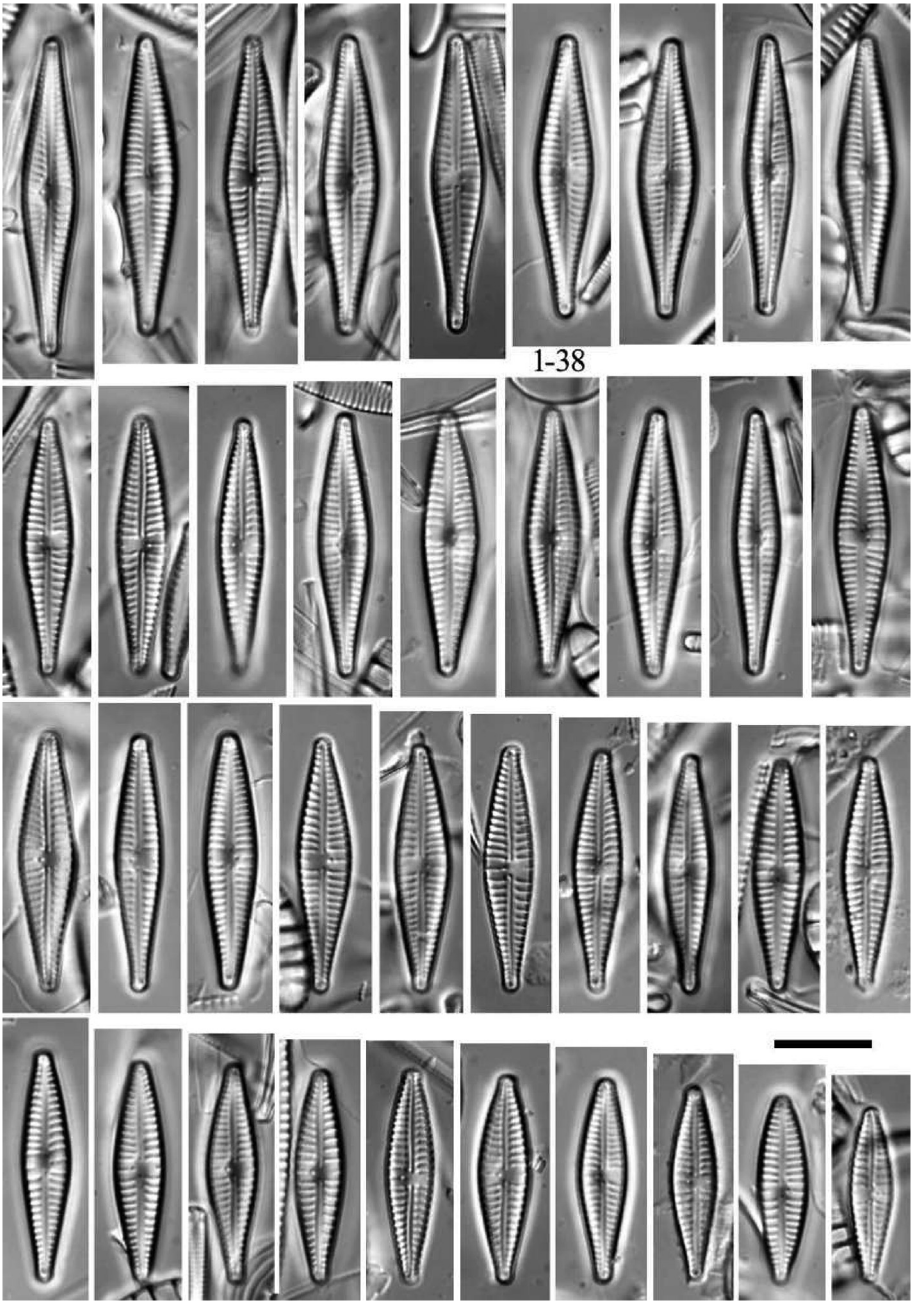

Plate 119 – *Gomphonema auritum* A. Braun ex Kützing (1.–38.).

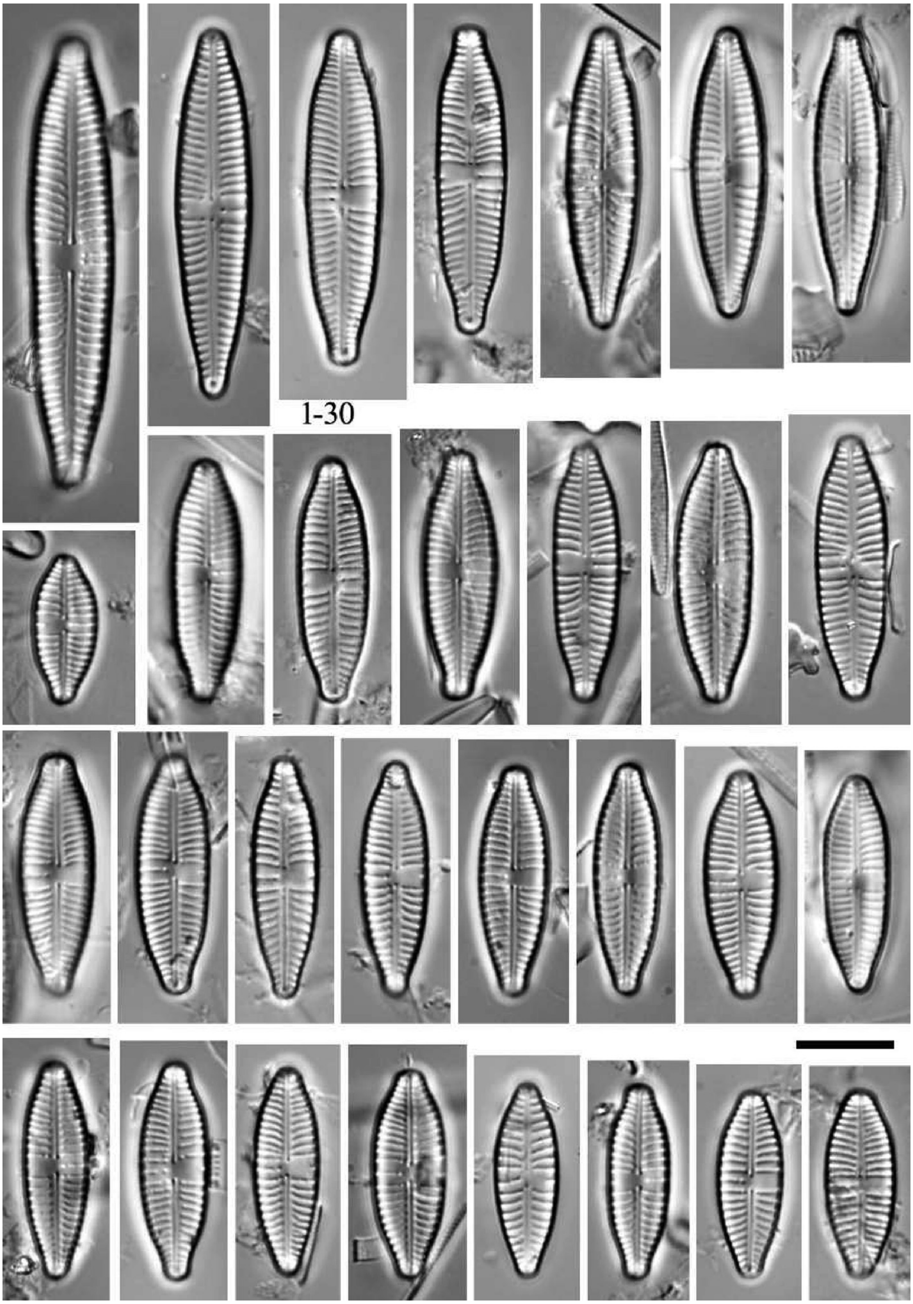

Plate 120 – *Gomphonema micropus* Kützing (1.–30.).

PLATE 121. *Gomphonema dichotomum* Kützing, *Gomphosinica hedinii* (Hustedt) Kociolek, You, Wang & Liu, *Gomphonella* sp. 1. nov. aff. *olivaceoides* var. *densestriata* Foged

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Figs 1–7. *Gomphonema dichotomum* Kützing

Figs 8–19. *Gomphosinica hedinii* (Hustedt) Kociolek, You, Wang & Liu

Valves are lanceolate-clavate, with both poles nearly capitate. The headpole is broad, more rostrate than rounded while the footpole is narrow then rounded. Valve length is 22–30 μm, valve width is 4.5–5.5 μm. The axial area straight, narrow, expanded laterally with striae of reduced but varying length on both sides giving the impression of an X-shaped central area. The central area bears a single, round stigma. The raphe is lateral and straight. Striae strongly radiate at the center, becoming parallel at both poles, not distinctly punctate. Striae number 12–15 in 10 μm. Apical pore fields indistinct. Septa and pseudosepta are present at the poles

Gomphosinica hedinii was described by Hustedt (1922) from Pamir and Tibet and later recorded by Shi (2004) and Li *et al.* (2003, 2008). Also, it was recorded in USA by Sovereign (1963) and Patrick and Reimer (1975). In the study area, it was infrequently recorded.

Figs 20–34. *Gomphonella* sp. 1. nov. aff. *olivaceoides* var. *densestriata* Foged

Valves are clavate with broadly subrostrate to subcapitate headpole and capitate footpole. In larger specimens margins might be slightly constricted near headpole. The axial area is linear and narrow. The central area is a transverse rectangle, formed by one to two shortened striae on each side of the valve. The four longest striae bordering the central area have an isolated stigmoid on the ends closest to the proximal raphe ends. The raphe is filiform, with the proximal ends slightly inflated and deflected to the secondary side of the valve. The striae radiate, transitioning to parallel at the head pole and strongly radiate at the foot pole. The genus Gomphonella Rabenhorst by including species around *Gomphonema olivaceum*, which have biseriate striae composed of round areolae and with or without four isolated pores. This taxon looks very similar to *Gomphonema olivaceoides* var. *densestriata* Foged, but slight differences can be noticed in the valve shape and stria density.

Scale bar = 10 μm
LM 1500x

Figs 1–34. Jiuzhaigou National nature reserve, various samples.

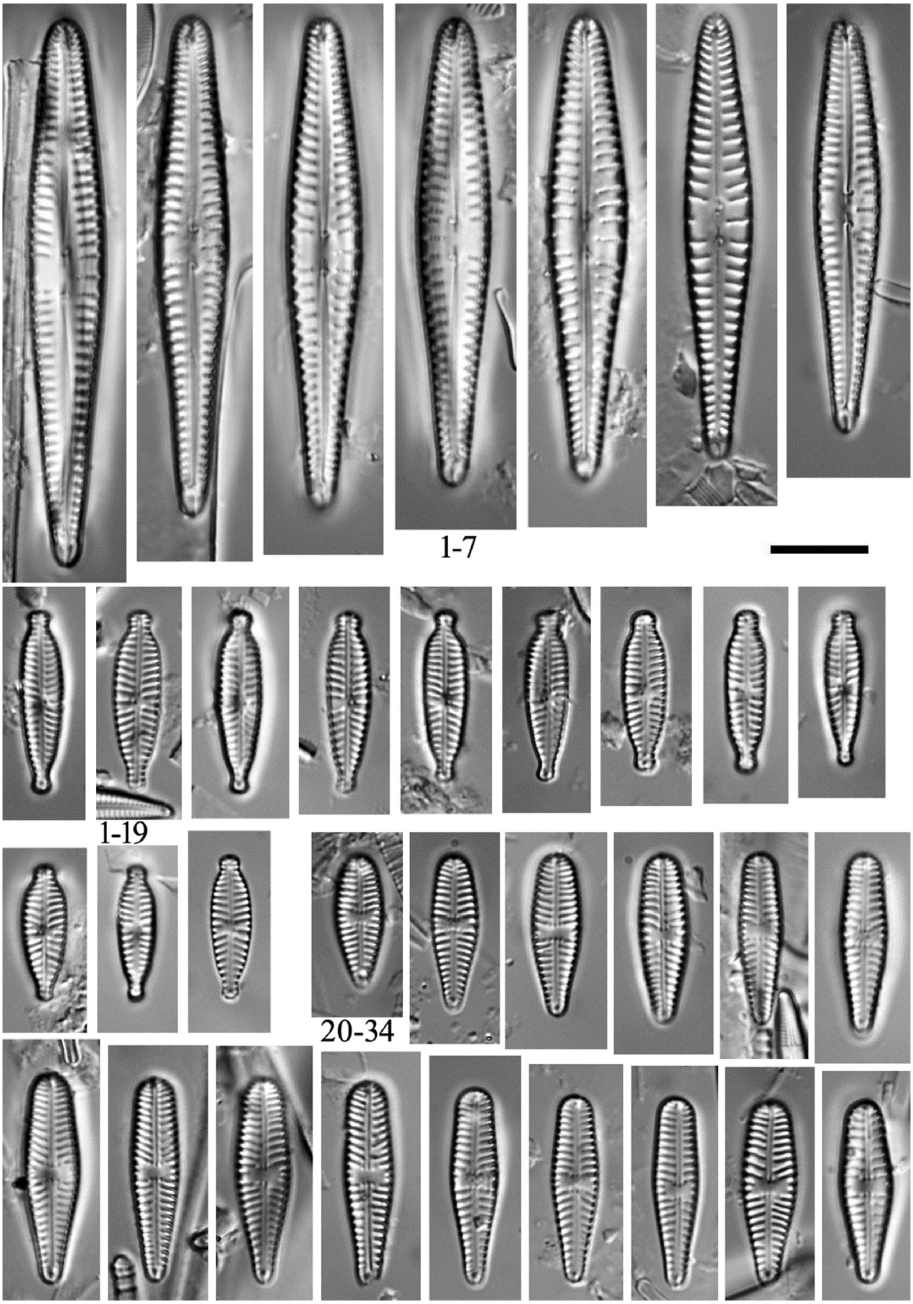

PLATE 121 – *Gomphonema dichotomum* Kützing (1.–7.), *Gomphosinica hedinii* (Hustedt) Kociolek, You, Wang & Liu (8.–19.), *Gomphonella* sp. 1. nov. aff. *olivaceoides* var. *densestriata* Foged (20.–34.).

PLATE 122. *Denticula tenuis* Kützing

Figs 1–59. *Denticula tenuis* Kützing

Valves are lanceolate to elliptical-lanceolate, with narrowly rounded to weakly protracted apices. Valve length is 10–19 μm, valve width is 3.5–6.0 μm. The raphe is not visible in LM, positioned off-center and contained within a canal its presence can be detected by the canal beneath the raphe, which is much more obvious and appears as two closely spaced, parallel, longitudinal lines in a subcentral position. Between each pair of fibulae is a faint but distinct elliptical aperture, which is the opening between the raphe canal and the cell lumen, formed by flaring of the fibula bases. In a frustule, the raphe systems of the two valves lie on opposite sides. The striae are punctate, 22–28 in 10 μm.

Denticula tenuis is considered a widely spread (cosmopolitan) species, and it is abundant in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–59. Jiuzhaigou National nature reserve, sample Acc. No. 72 – 2H.

PLATE 123. *Denticula* sp. 1.

Figs 1–54. *Denticula* sp. 1.

Valves are linear to narrowly linear-lanceolate, with almost parallel margins and narrowly rounded to apiculate apices. Valve length is 14–26 μm, valve width is 3.5–4.0 μm. The raphe is not visible in LM, positioned off-center and contained within a canal its presence can be detected by the canal beneath the raphe, which is much more obvious and appears as two closely spaced, parallel, longitudinal lines in a subcentral position. Between each pair of fibulae is a faint but distinct elliptical aperture, which is the opening between the raphe canal and the cell lumen, formed by flaring of the fibula bases. In a frustule, the raphe systems of the two valves lie on opposite sides. The striae are punctate, 24–30 in 10 μm.

Denticula sp. 1. nov. differs from Denticula tenuis by its shape (linear) and valve narrower valve width. This species was common in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–54. Jiuzhaigou National nature reserve, sample Acc. No. 1.

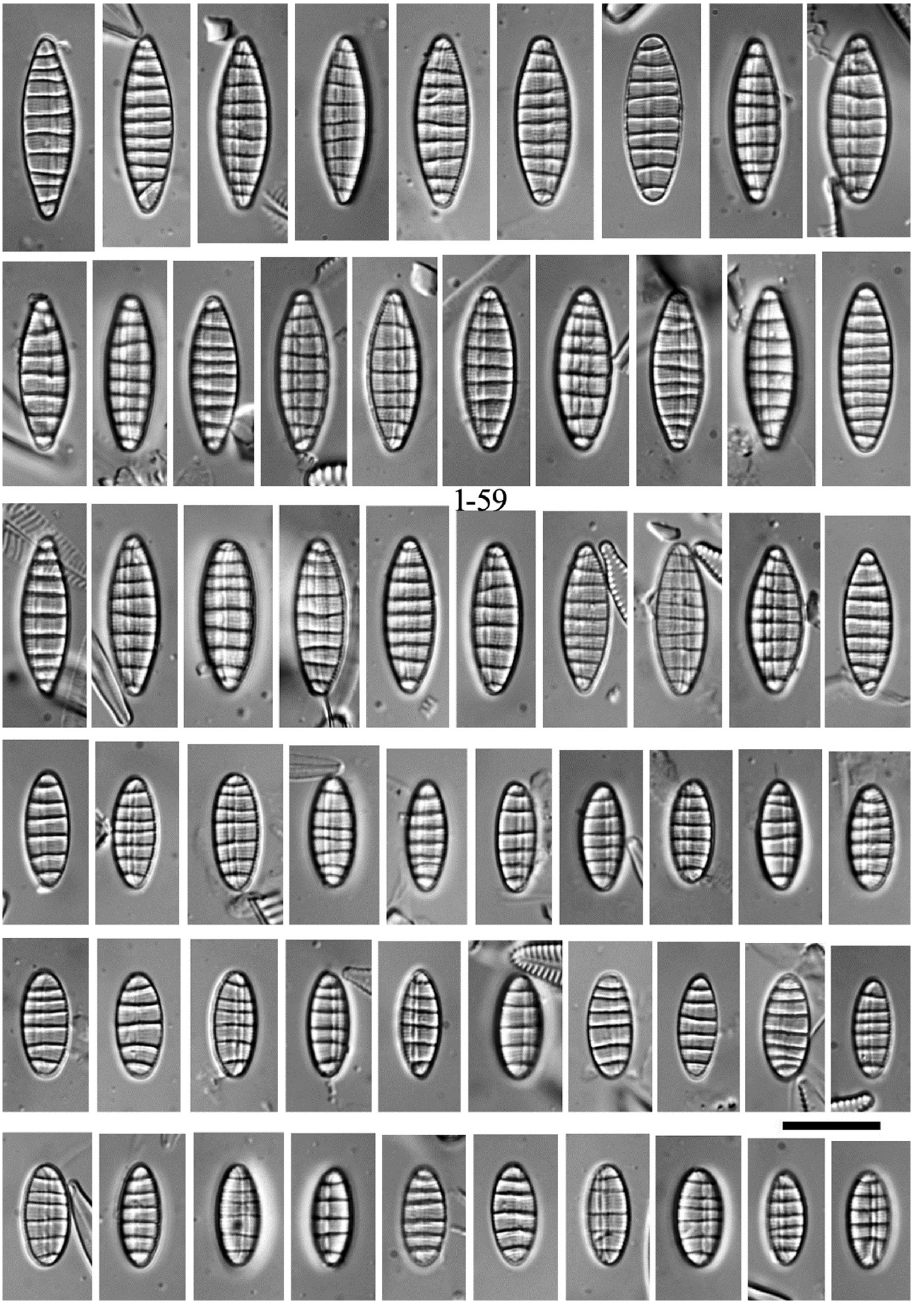

PLATE 122 – *Denticula tenuis* Kützing (1.–59.).

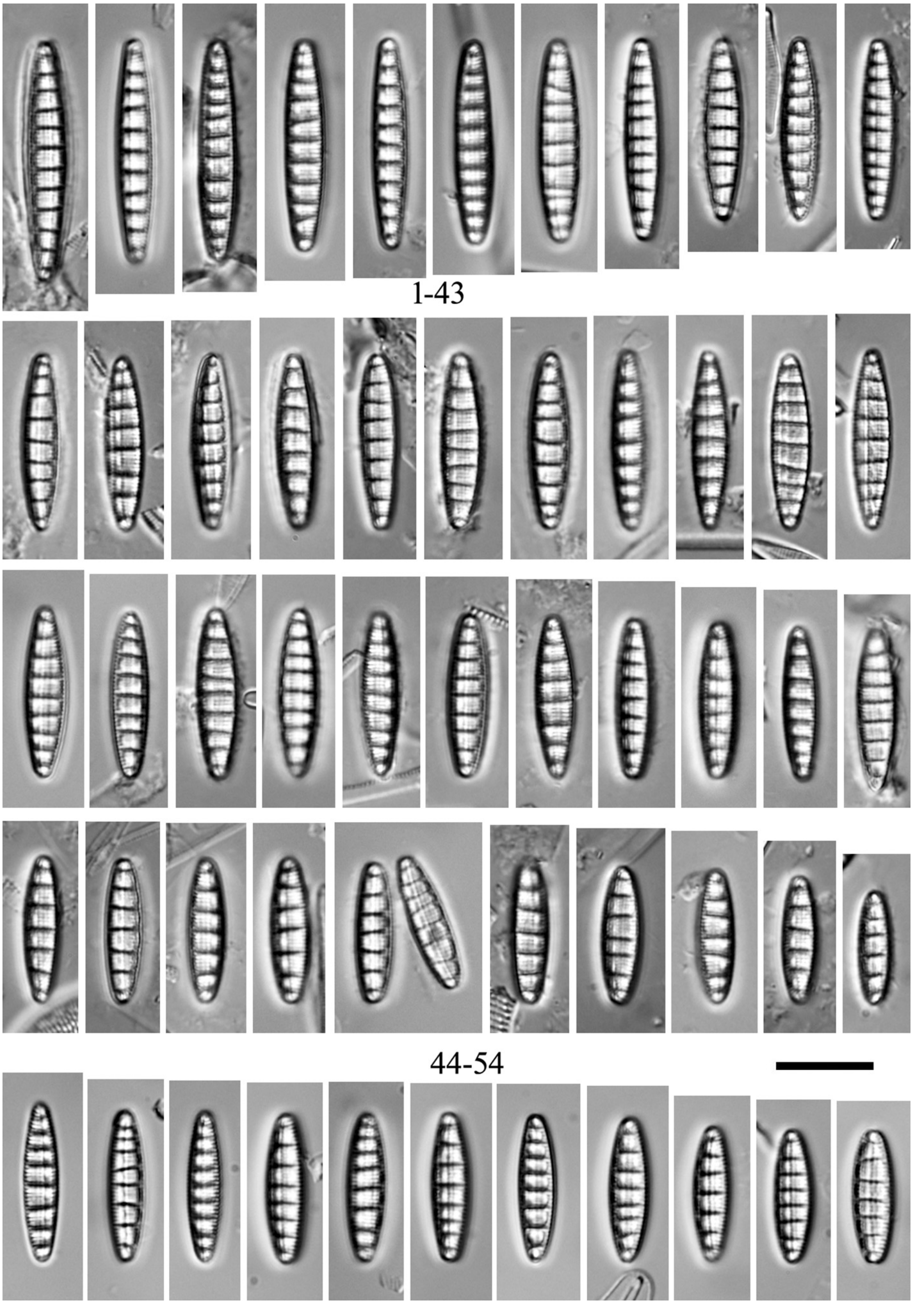

PLATE 123 – *Denticula* sp. 1. (1.–54.).

PLATE 124. *Nitzschia denticula* Grunow

Figs 1–19. *Nitzschia denticula* Grunow

Valves are linear to lanceolate and taper to narrowly rounded apices. Valve length is 17–61 μm, valve width is 5.0–8.0 μm. The raphe is eccentric and located within a canal. The raphe lacks a central nodule. Fibulae are thick at the valve margin and typically extend across value to the opposing margin, although this feature is not visible in all specimens. Fibulae are irregularly spaced along the valve margin with 1–4 striae separating them. Striae are distinctly punctate, 14–18 in 10 μm.

Nitzschia denticula might be also identified as *Denticula kuetzingii* Grunow and both names can be found in the literature. However, molecular analyses suggested that it belongs to Nitzschia (Tuji, 2016). This species was common in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–19. Jiuzhaigou National nature reserve, sample Acc. No. 4.

PLATE 125. *Nitzschia denticula* Grunow

Figs 1–37. *Nitzschia denticula* Grunow

Valves are linear to lanceolate and taper to narrowly rounded apices. Valve length is 17–61 μm, valve width is 5.0–8.0 μm. The raphe is eccentric and located within a canal. The raphe lacks a central nodule. Fibulae are thick at the valve margin and typically extend across value to the opposing margin, although this feature is not visible in all specimens. Fibulae are irregularly spaced along the valve margin with 1–4 striae separating them. Striae are distinctly punctate, 14–18 in 10 μm.

Nitzschia denticula might be also identified as *Denticula kuetzingii* Grunow and both names can be found in the literature. However, molecular analyses suggested that it belongs to Nitzschia (Tuji, 2016). This species was common in the samples from Jiuzhaigou National nature reserve.

On this plate, medium- and small-celled specimens are illustrated.

Scale bar = 10 μm
LM 1500x

Figs 1–37. Jiuzhaigou National nature reserve, sample Acc. No. 4.

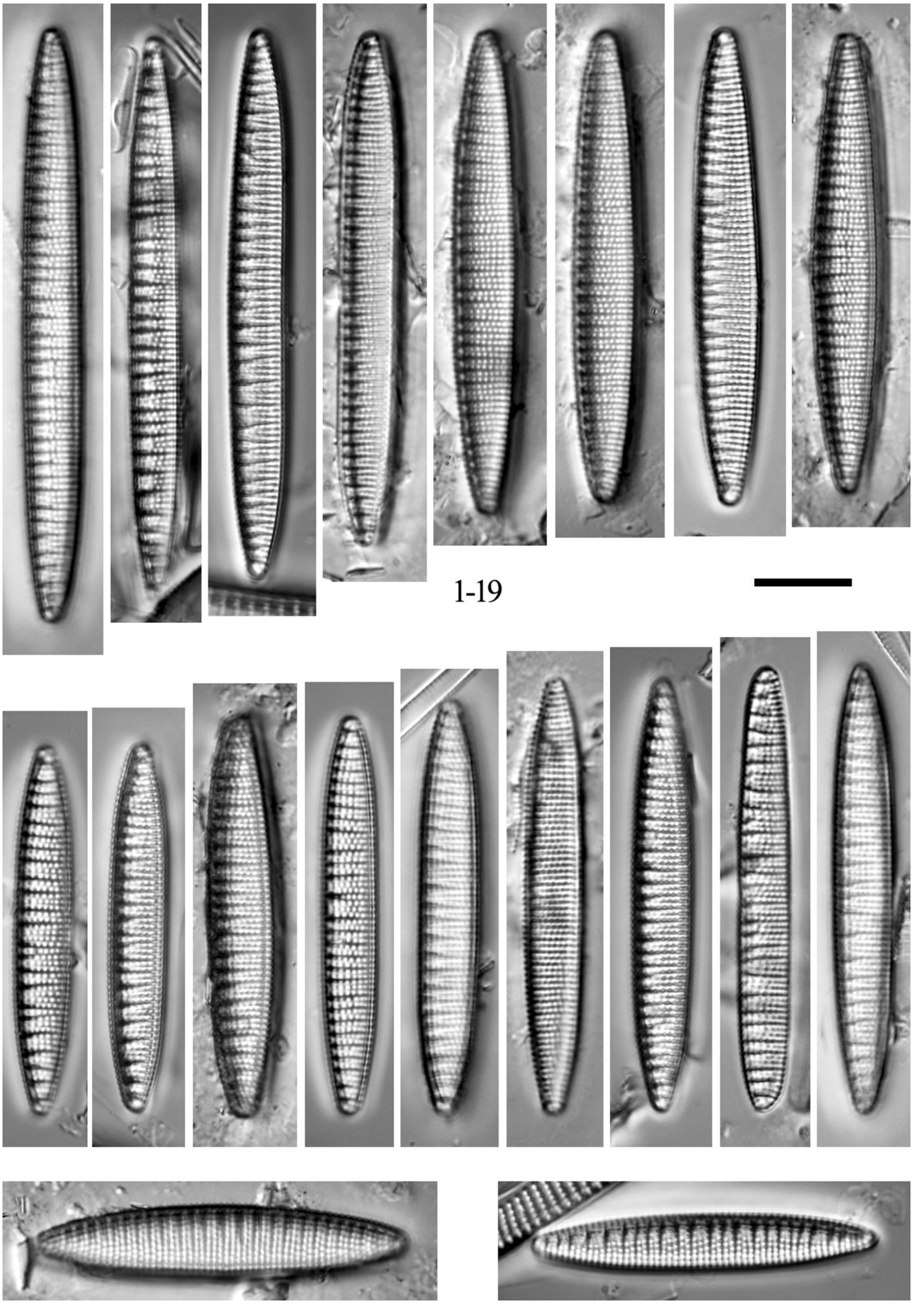

Plate 124 – *Nitzschia denticula* Grunow (1.–19.).

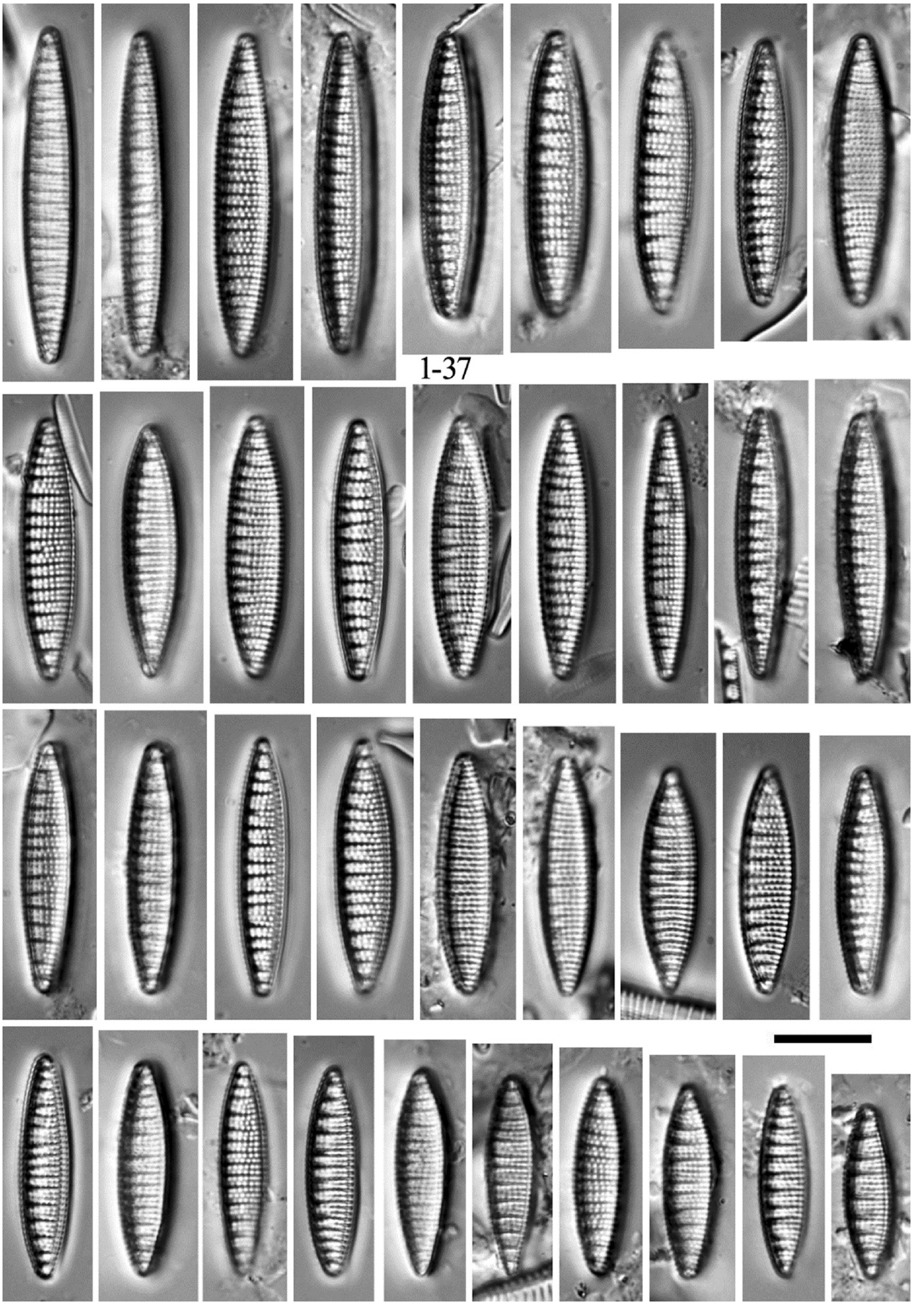

Plate 125 – *Nitzschia denticula* Grunow (1.–37.).

PLATE 126. *Grunowia solgensis* (A. Cleve) Aboal, *Hantzschia abundans* Lange-Bertalot, *Hantzschia amphioxys* (Ehrenberg) Grunow, *Hantzschia amphioxys* var. *aequalis* Cleve-Euler, *Surirella minuta* Brébisson ex Kützing, *Nitzschia monachorum* Lange-Bertalot, *Nitzschia recta* Hantzsch, *Nitzschia diversa* Hustedt

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Figs 1–9. *Grunowia solgensis* (A. Cleve) Aboal

Valves are lanceolate to linear-lanceolate. Larger valves have protracted apices, while smaller valves with not protracted and rounded apices. Valve length is 11–21 μm, valve width is 3.5–4.5 μm. Raphe is continuous without central nodule. Striae are punctate, parallel to slightly radiate, 18–25 in 10 μm. Areolae are coarse and irregularly spaced, particularly near the apical axis. Fibulae are coarse and extend approximately to the apical axis, 5–8 in 10 μm.

Several species from the genus Grunowia from P.R. China have been studied by Liu *et al.* (2017b).

Fig. 10. *Hantzschia abundans* Lange-Bertalot

Valves are asymmetrical to the apical axis. Ventral margin is concave at center, slightly convex at the poles, dorsal margin is convex. Valve ends shortly protracted and. Valve length is 34–43 μm, and breadth 6.5–7.0 μm. Fibulae, 9–12 in 10 μm, almost equidistant, the median two more distant than the others, each of them connected with two transapical costa. Striae parallel throughout, some slightly radiate in the center, 22–24 in 10 μm. Striae puncta not discernible in LM.

Figs 11–13. *Hantzschia amphioxys* (Ehrenberg) Grunow

Fig. 14. *Hantzschia amphioxys* var. *aequalis* Cleve-Euler

Members of the genus Hantzschia (Bacillariophyta) in Xinjiang Province were studied in detail by You *et al.* (2015) and several new species have been described.

Figs 15, 16. *Surirella minuta* Brébisson ex Kützing

Fig. 17. *Nitzschia monachorum* Lange-Bertalot

Figs 18–21. *Nitzschia recta* Hantzsch

Figs 22–24. *Nitzschia diversa* Hustedt

Scale bar = 10 μm
LM 1500x

Figs 1–24. Jiuzhaigou National nature reserve, various samples.

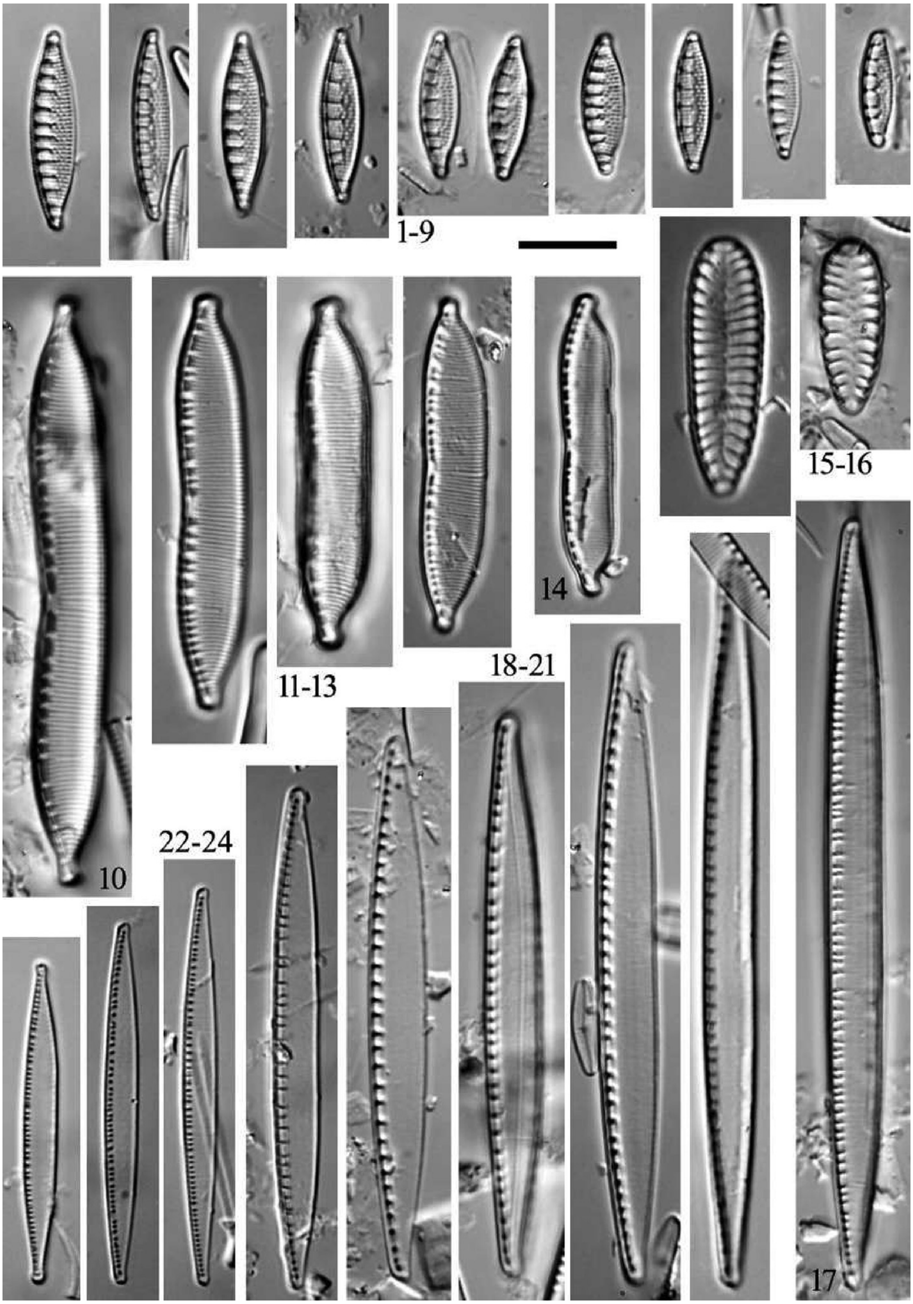

Plate 126 – *Grunowia solgensis* (A. Cleve) Aboal (1.–9.), *Hantzschia abundans* Lange-Bertalot (10.), *Hantzschia amphioxys* var. *aequalis* Cleve-Euler (14.), *Surirella minuta* Brébisson ex Kützing (15., 16.), *Nitzschia monachorum* Lange-Bertalot (17.), *Nitzschia recta* Hantzsch (18.–21.), *Nitzschia diversa* Hustedt (22.–24.).

PLATE 127. *Nitzschia gisela* Lange-Bertalot, *Nitzschia linearis* W. Smith, *Nitzschia rectirobusta* Lange-Bertalot

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Figs 1–5, 8, 9. *Nitzschia gisela* Lange-Bertalot

Valves are linear slightly constricted in the middle. Valve ends are capitate. Valve length is 79–98 μm, valve width is 5.0–7.5 μm. The raphe is positioned at the valve margin. Central nodule is distinct. Fibulae are coarse 9–12 in 10 μm. Striae are parallel, finely punctate, 18–22 in 10 μm. Areolae are discernible with LM, 24–26 in 10 μm.

Nitzschia gisela is considered a widely spread (cosmopolitan) species, and it is abundant in the samples from Jiuzhaigou National nature reserve.

Fig. 6. *Nitzschia linearis* W. Smith

Fig. 7. *Nitzschia rectirobusta* Lange-Bertalot

Scale bar = 10 μm
LM 1500x

Figs 1–9. Jiuzhaigou National nature reserve, sample Acc. No. 11.

PLATE 128. *Nitzschia gessneri* Hustedt

Figs 1–23. *Nitzschia gessneri* Hustedt

Valves are linear to linear-lanceolate and slightly constricted in the middle. Valve ends are capitate and slightly ventrally bent. Valve length is 48–63 μm, valve width is 3.0–4.0 μm. The raphe is positioned at the valve margin. Central nodule is indistinct. Fibulae are coarse 10–12 in 10 μm. Striae are parallel, finely punctate, 26–28 in 10 μm. Areolae are discernible with LM, 25–30 in 10 μm.

Nitzschia gessneri is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–23. Jiuzhaigou National nature reserve, sample Acc. No. JGP B1 V1.

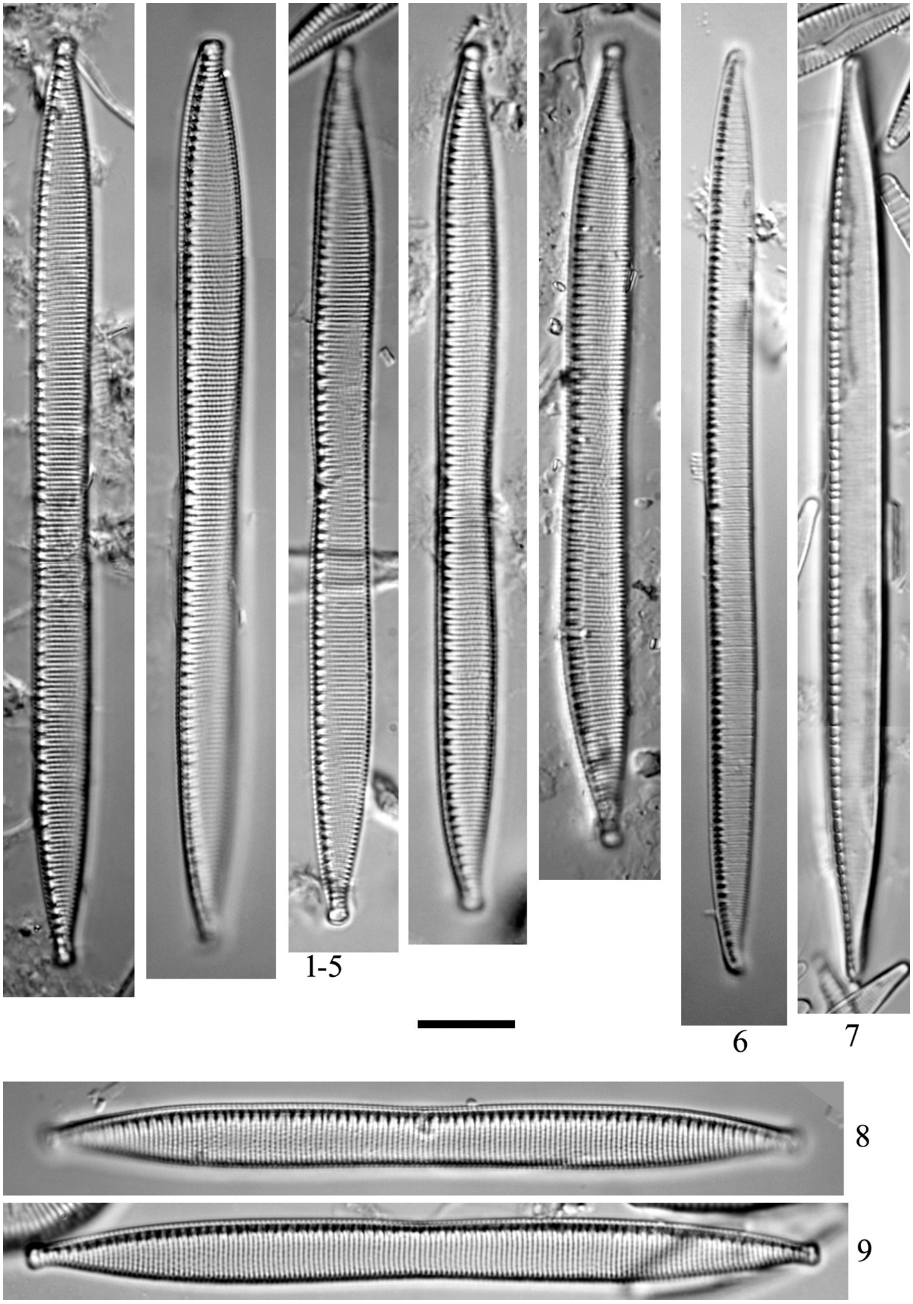

PLATE 127 – *Nitzschia gisela* Lange-Bertalot (1.–5., 8., 9.), *Nitzschia linearis* W. Smith (6.), *Nitzschia rectirobusta* Lange-Bertalot (7.).

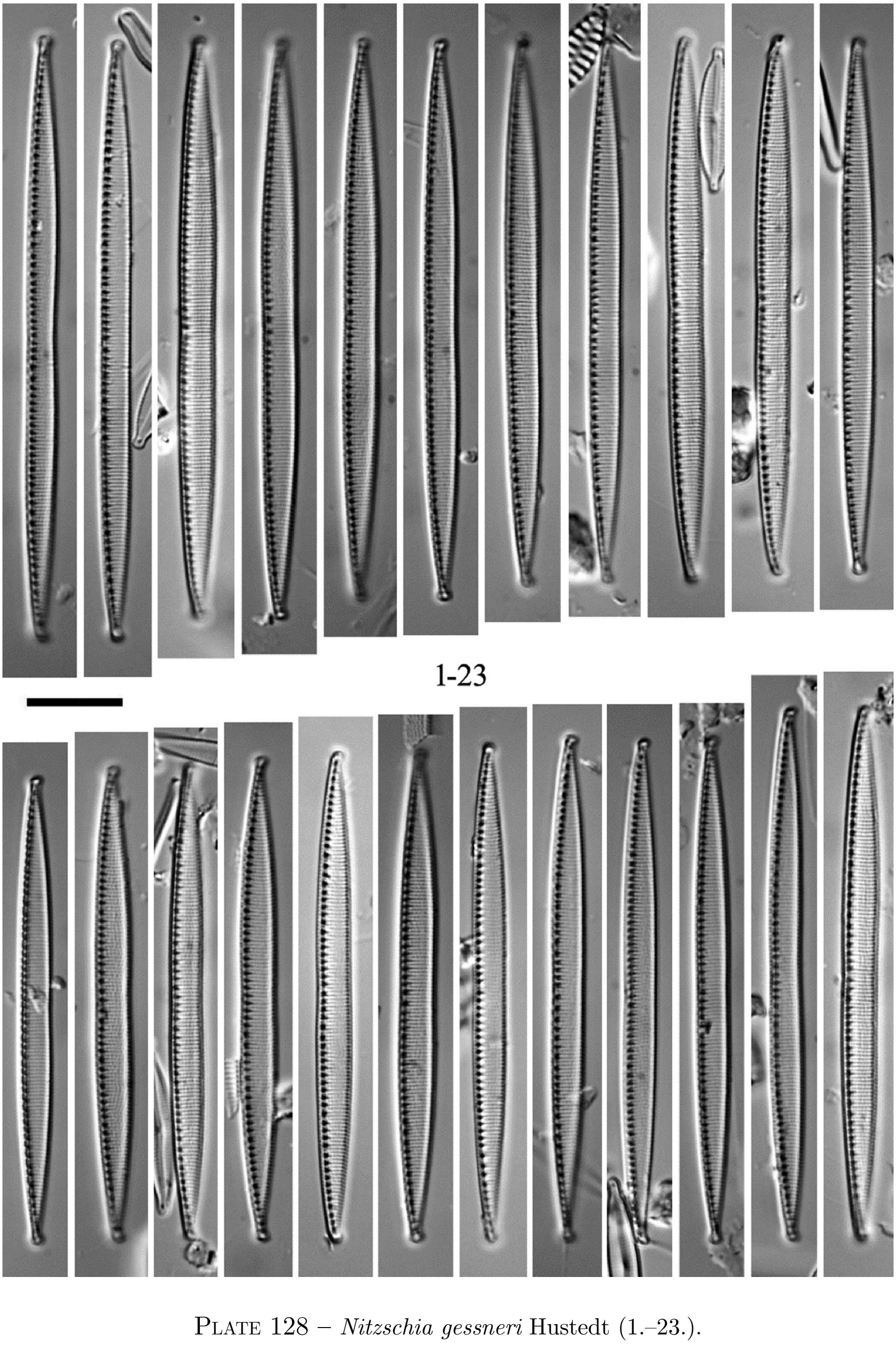

Plate 128 – *Nitzschia gessneri* Hustedt (1.–23.).

PLATE 129. *Nitzschia fossilis* (Grunow) Grunow

Figs 1–30. *Nitzschia fossilis* (Grunow) Grunow

Valves are lanceolate to linear-lanceolate to almost parallel in the middle. Valve ends are slightly rostrate to capitate. Valve length is 32–49 μm, valve width is 4.0–5.0 μm. The raphe is positioned at the valve margin. Central nodule is indistinct. Fibulae are coarse 9–10 in 10 μm. Striae are parallel, finely punctate, 18–21 in 10 μm. Areolae are discernible with LM, around 30 in 10 μm.

Nitzschia fossilis is considered a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–30. Jiuzhaigou National nature reserve, sample Acc. No. 42.

PLATE 130. *Nitzschia* sp. aff. *archibaldi*i Lange-Bertalot, *Nitzschia fonticola* (Grunow) Grunow, *Nitzschia* sp. 1., *Nitzschia dealpina* Lange-Bertalot & Hofmann, *Nitzschia bulnheimiana* (Rabenhorst) H.L. Smith, *Nitzschia jucunda* Hustedt

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Figs 1–18. *Nitzschia* sp. aff. *archibaldii* Lange-Bertalot
Figs 19–25. *Nitzschia fonticola* (Grunow) Grunow
Figs 26–35. *Nitzschia* sp. 1.
Figs 36, 37. *Nitzschia dealpina* Lange-Bertalot & Hofmann
Fig. 38. *Nitzschia bulnheimiana* (Rabenhorst) H.L. Smith
Figs 39–44. *Nitzschia jucunda* Hustedt
Figs 45, 46. *Nitzschia* sp. 1.

Scale bar = 10 μm
LM 1500x

Figs 1–46. Jiuzhaigou National nature reserve, various samples.

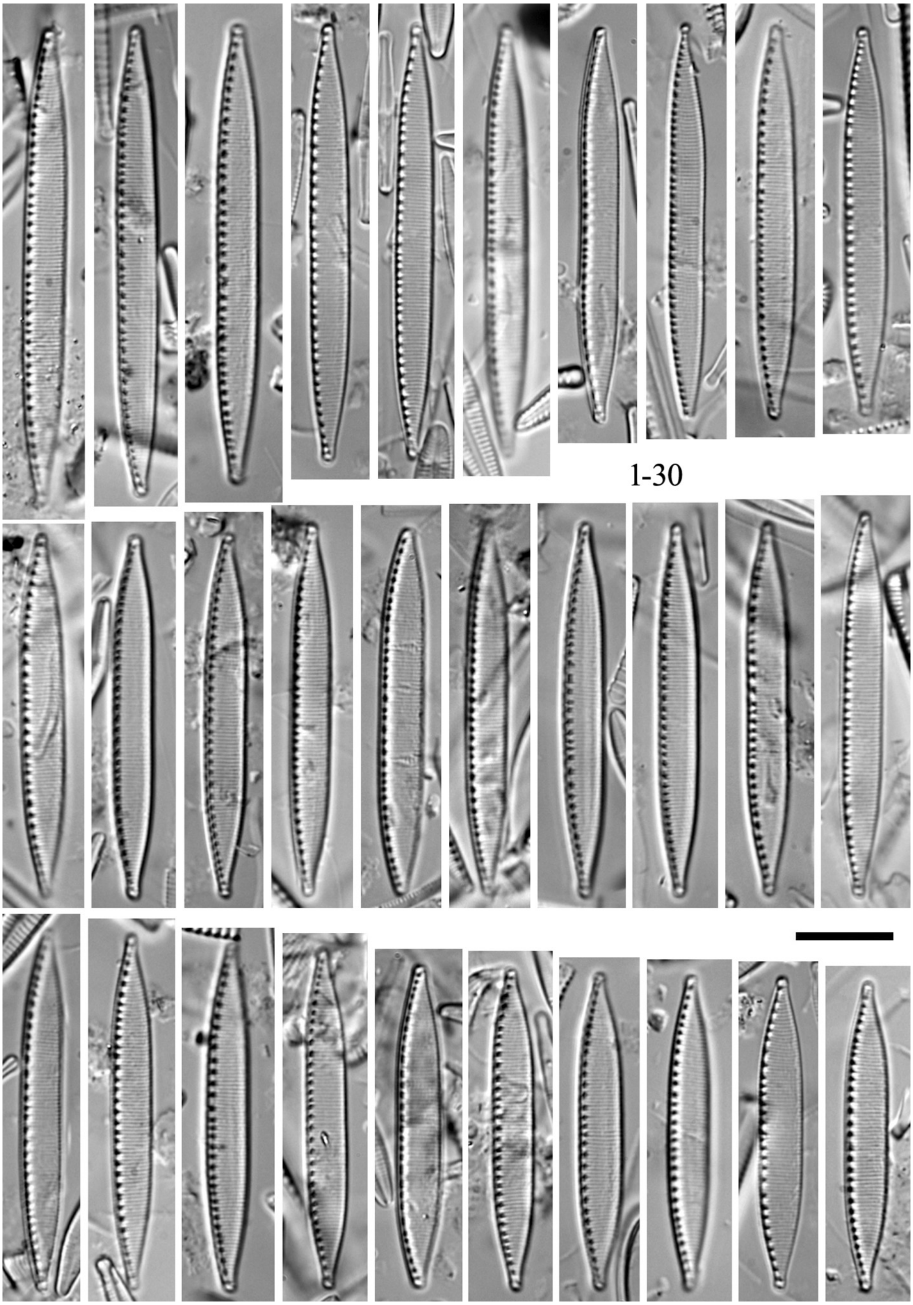

Plate 129 – *Nitzschia fossilis* (Grunow) Grunow (1.–30.).

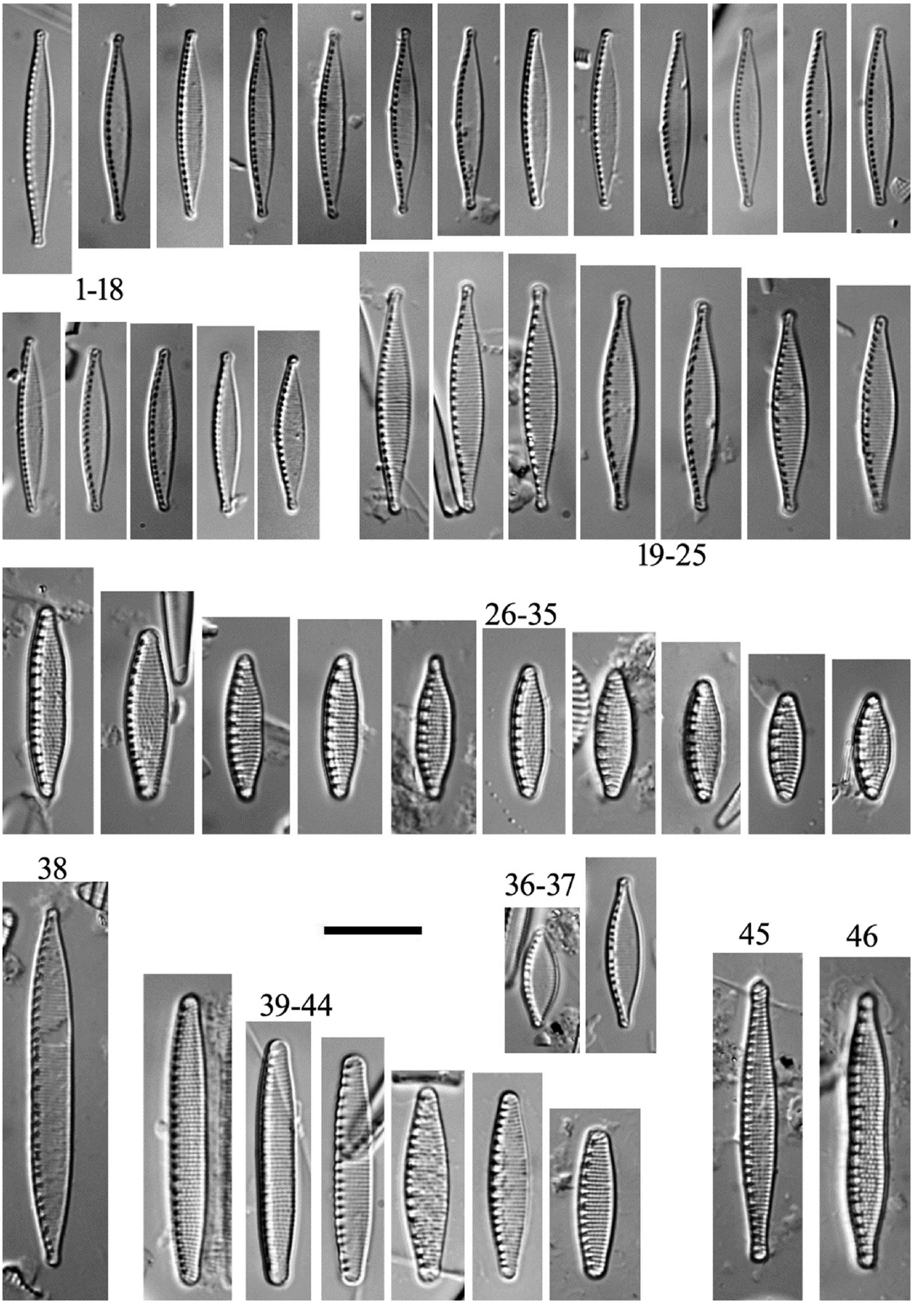

PLATE 130 – *Nitzschia* sp. aff. *archibaldii* Lange-Bertalot (1.–18.), *Nitzschia fonticola* (Grunow) Grunow (19.–25.), *Nitzschia* sp. 1. (26.–35., 45., 46.), *Nitzschia dealpina* Lange-Bertalot & Hofmann (36.–37.), *Nitzschia bulnheimiana* (Rabenhorst) H.L. Smith (38.), *Nitzschia jucunda* Hustedt (39.–44.).

PLATE 131. *Tryblionella angustata* W. Smith

Figs 1–19. *Tryblionella angustata* W. Smith

Valves are linear-lanceolate, with the central margins nearly parallel. Apices are subrostrate and narrowly rounded. Valve length is 33–66 μm, valve width is 5.0–6.5 μm. The striae are distinctly punctate, 15–18 in 10 μm with coarse areolae 24–27 in 10 μm. The fibulae are in line with the striae, and may be difficult to discern. A central, longitudinal fold is absent.

Tryblionella angustata is considered as a widely spread (cosmopolitan) species, and it was frequently observed in the samples from Jiuzhaigou National nature reserve.

Scale bar = 10 μm
LM 1500x

Figs 1–19. Jiuzhaigou National nature reserve, sample Acc. No. 42.

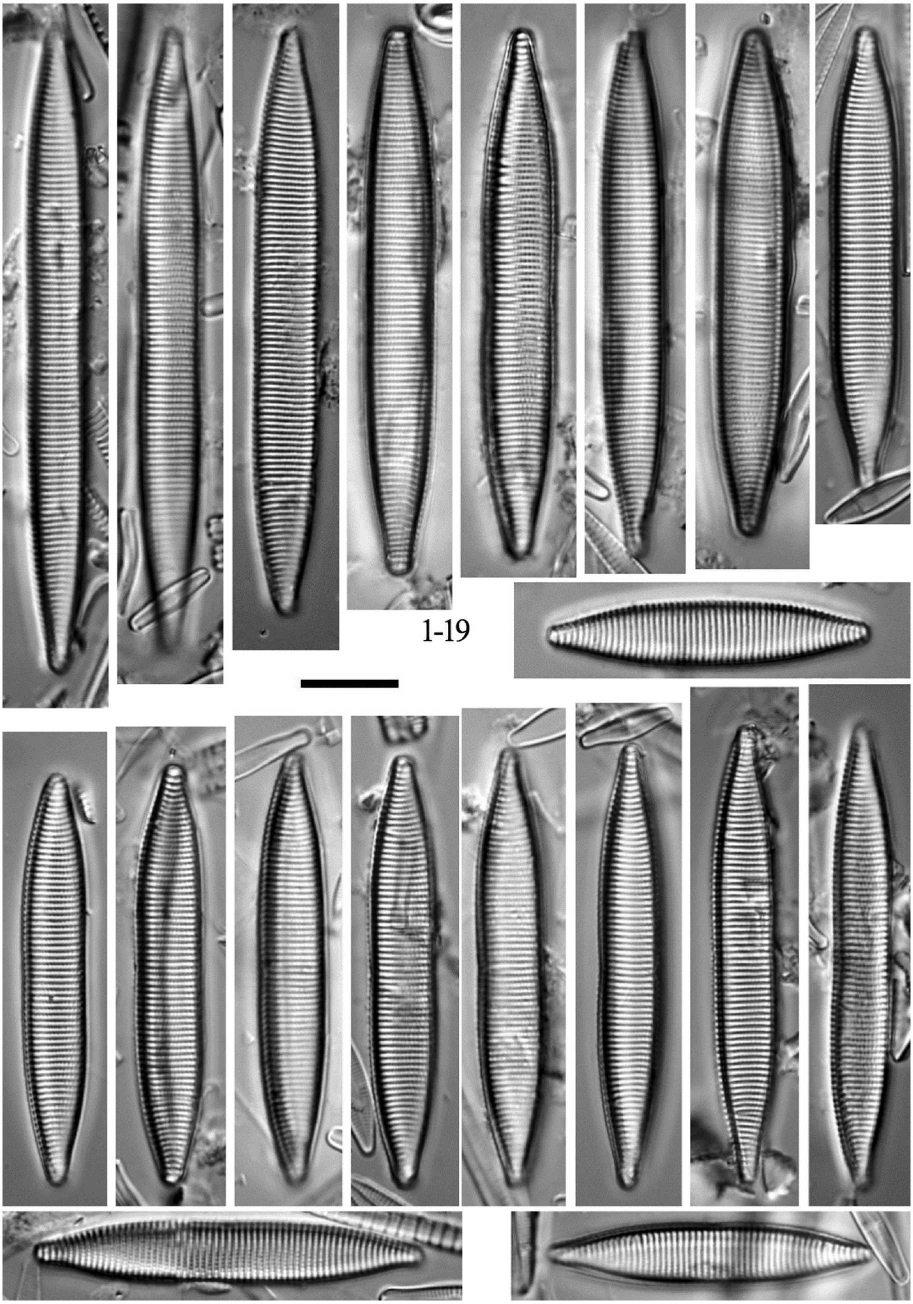

Plate 131 – *Tryblionella angustata* W. Smith (1.–19.).

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Meanings of the Most Common Latin Abbreviations Used in Taxa

Abbrevation	Meaning	Explanation
aff.	affinis	having affinity with but is not identical with
cf.	confer	probably belongs to the identified species (*refer to* or *compare with*)
f.	forma	something like variety
group		varies species combined under one group which are difficult to distinguish (combines at least 2 taxa)
p.p.	pro parte	used in nomenclature to denote that a taxon includes more than one currently recognized entity, and that only one of those entities is being considered
s.ampl.	sensu amplo	in a relaxed, generous (or 'ample') sense, a similar meaning to *sensu lato*.
s.f.	sensu forma	in the form (taxonomy) sense
s.l.	sensu lato	in the broader sense
sp. nov.	species nova	phrase used when publishing the name of a new species
s.str.	sensu stricto	in the strict (narrow) sense
sensu		species identification following a particular author
sp.	species	determination of one species which was identified only at generic level
sp. A or sp.1		authors personal identification of a species; not to be defined as parameter
spp.		determination of several species, which were identified only at generic level (plural of sp.)
ssp.	subspecies	identification below species level
var.	varietas	variety of a species (*e.g.* in shape or color); no real status in nomenclature
var. cf.	varietas confer	probably belongs to the identified variety